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EXTRACTION OF TEETH



EXTRACTION OF TEETH

BY

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WITH FIFTY-SIX ILLUSTRATIONS

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PREFACE

IN this small work I have endeavoured to treat a subject of interest both to the general and dental practitioner.

Although it is a worthy aim to treat teeth where possible by conservative measures, these measures may be persisted in to the detriment of the patients' health, and a distinct line must be recognized between the possibility of restoring to function a tooth or root and the advisability of so doing.

Teeth are more easily made comfortable to the patient than to his tissues, and a difficult point often arises in how far the latter and more stringent test is to be considered.

Disease in distant parts of the body has not infrequently been traced to teeth filled or crowned, and relieved by their removal. It is with the above points in view that I venture to bring this subject forward.

I have to express my obligation to Mr. Tomes and Mr. Colyer for some of the illustrations I have borrowed from their works, and to Messrs. Ash, and Smith, Elder and Co., for most of the remainder; my thanks are further due to the latter for the freedom they have allowed me in quoting from my father's 'Manual of Dental Surgery.'

Finally, I am indebted to Dr. Austen for his kindness in looking through my revised pages.

F C.

June, 1908.

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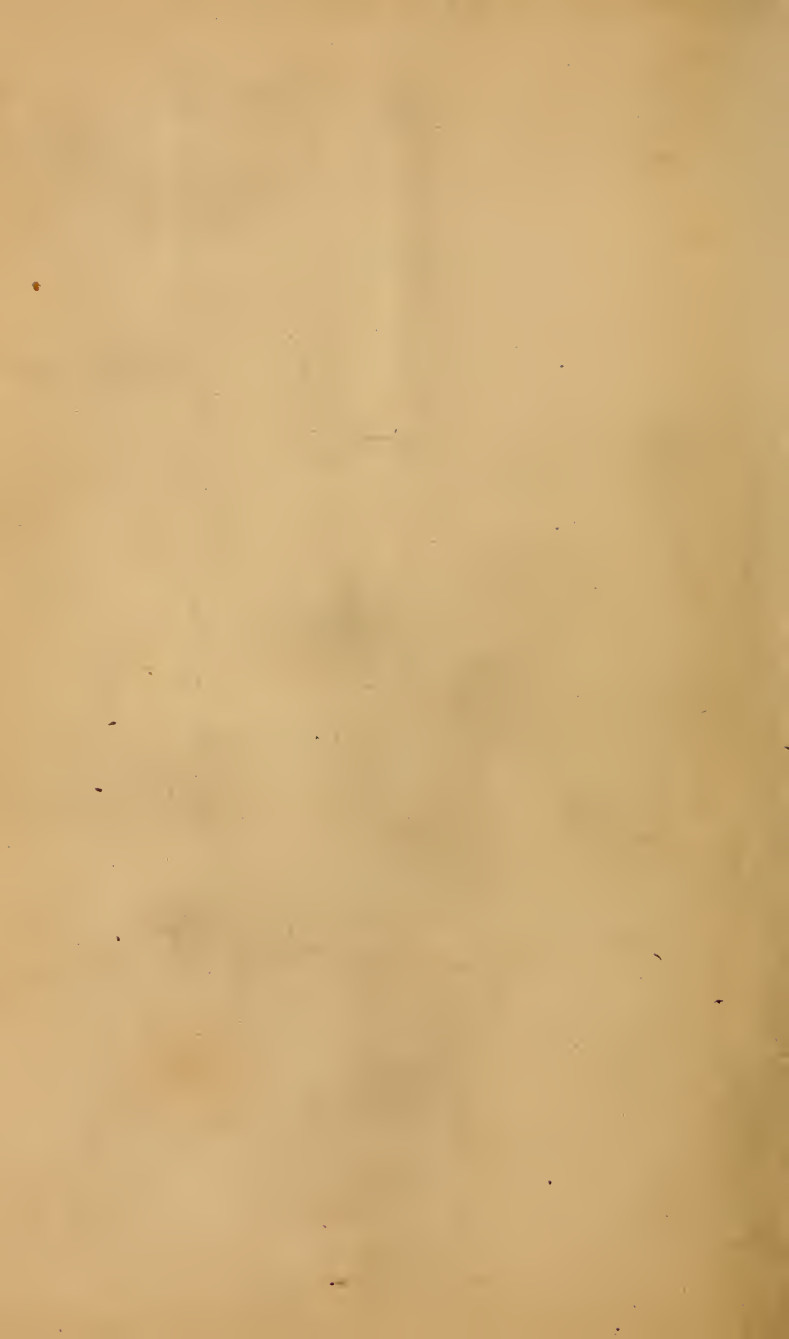
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EXTRACTION OF TEETH

CHAPTER I

EXTRACTION OF TEETH

THE operation of extraction is one which requires skill, judgment, experience, and an accurate knowledge of the anatomy of the teeth themselves and their surrounding parts.

Before determining to resort to extraction it is necessary to consider the *indications for such*, and these will now be stated in a general way, although it must be clearly understood that many other factors may arise which will influence the treatment to pursue in an otherwise undebatable case.

1. Teeth which have become so loose from absorption or destruction of their alveoli as to be quite useless—indeed, impediments to mastication.

2. Teeth long affected with chronic periodontitis, where treatment, both local and general, has failed to give any relief.

3. Teeth carious or injured to such an extent that it would be inadvisable to adopt conservative treatment.

4. Teeth erupted in abnormal positions, incapable of being brought into position, and interfering with the comfort of the tongue, lips, or cheek, and by assuming such position predisposing to caries of the adjoining teeth.

5. Where the teeth are crowded to such an extent that their usefulness is impaired.

6. Teeth the cause of inflammation and suppuration of surrounding parts, when it appears improbable that the latter can be immediately and permanently relieved by drainage through their canal, or canals, with, in addition, a counter-opening over the most dependent part of the swelling, and where delay in giving such relief may lead to the abscess opening in some unfavourable position.

In some of the more severe cases, the removal of the tooth alone does not allow of sufficient drainage, and a counter-opening at some distant part—*e.g.*, in the neck or face—is not only necessary, but the more urgent part of the treatment.

7. Teeth in connexion with which there is necrosed bone, a sinus, or other pathological condition.

8. In a person of feeble health, when to save a tooth would necessitate a long and tedious operation.

9. Teeth causing inflammation or ulceration of the tongue, lips, cheeks, or other adjoining soft parts, or aggravating existing ulceration of these parts, if the tooth or teeth are not readily amenable to other treatment, or where it is desirable to remove all sources of possible irritation, both immediately and permanently.

10. Carious teeth causing enlargement of the lymphatic glands, or where such teeth possibly act as a source of irritation to lymphatic tissue already diseased from tuberculous lymphadenitis, lymphadenoma, or hyperplasia from other conditions.

11. When a tooth is rendered useless from extrusion caused by the loss of its antagonist, and prevents proper occlusion being restored in those cases where artificial aid

is required; or the more numerous cases where one or more teeth, standing together or apart, are the only teeth remaining in the jaws, and, from their condition or position, are unsuitable for retaining when artificial substitutes are being considered.

12. In cases of intractable trigeminal neuralgia which have resisted all general and local measures short of operative treatment.

Unsuccessful as extraction generally is in these cases, this form of treatment should not be passed over in such a terrible disease when there is the prospect of the slightest benefit to be gained, and before the larger operations are contemplated.

13. To allow space for feeding purposes in some cases of permanent closure of the jaw—*e.g.*, ankylosis of the temporo-maxillary articulation, intra- or extra-buccal cicatrization from various causes, epithelioma infiltrating the masseteric and pterygoid regions, etc.

In these cases the teeth are best removed in the premolar region, on the side opposite to that of the lesion, provided there are no indications for removing others. Both upper and lower teeth in this region should be removed, and when firmly locked, it is impossible to do so without first fracturing one of them, in order to gain space for the forceps.

14. Occasionally teeth require removal as a preliminary to other larger operations—*e.g.*, excision of the maxilla or mandible, epithelioma involving the frænum of the tongue and its vicinity.

The latter three indications for the removal of teeth do not often present themselves, although, personally, I have had instances of all these conditions.

Some of the chief indications for the extraction of teeth having been given, when such is determined upon, a careful

examination of the tooth to be removed should be made, noting especially the amount of sound tooth-substance present, its relation to surrounding structures, and the amount of force which will probably be necessary for its removal.

In the case of very hollow teeth the amount of sound tissue present and the density of such must be carefully gauged by means of a blunt probe, and if part of the tooth be carious below the gum, or in the case of roots, the edges of such must be defined.

The most useful probe for this purpose is one with a blade nearly $\frac{3}{4}$ inch in length, flattened in the same plane as the handle, and nearly at a right angle to the latter, the instrument being made in one piece of metal (Fig. 1).

Any resistance at the extremity of the instrument will be directly conveyed to the tip of the palmar surface of the first finger, the most responsive part of the hand to the sensation of touch.

A probe having a sharp point is also useful at times—*e.g.*, in *determining the density* of a hard substance in the gum, and likewise any mobility. A substance feeling very dense and slightly mobile would be in favour of its being a portion of a root of a tooth, whereas a substance

as hard, or nearly so, but absolutely rigid, would be much more likely to be part of a socket of a tooth.

Where a portion of the alveolus has become separated,



FIG. 1.

this will generally convey the impression of a substance softer and more porous, especially if such separation is not quite recent, and its mobility will not be restricted, particularly in any one direction.

A portion of a healthy root, if seen, will present a white, ivory appearance, and, if felt, will be found to yield slightly



FIG. 2.

in a lateral direction. Beyond this, skiagraphy would be the only means of clearing up any doubt.

The margins of a root become better defined, and its character more easily determined after drying with cotton-wool. For this purpose tweezers are useful and a mirror necessary for the back of the mouth (Figs. 2 and 3).



FIG. 3.

The following *conditions* must be observed in order to carry out the operation of extraction successfully :

1. All instruments introduced into the mouth should be first rendered *sterile* by boiling in water for at least three minutes, and then transferred to some antiseptic solution. This applies to all instruments except those which may be strictly termed cutting instruments ; for these we must rely chiefly on chemical sterilization, as the former method injures their sharpness.

A small quantity of soda is added to the water to prevent rusting of the instruments and for removing grease ; it likewise raises its boiling-point.

2. The offending tooth should be removed in its *entirety* with the least possible injury to surrounding parts, and as rapidly as is consistent with safeness.

3. The after-treatment must be directed to keeping the mouth and wounded parts as *clean* as possible, and so reducing any liability to septic infection.

By carrying out the above principles, the patient will be spared all unnecessary pain, both at the time of the operation and subsequently during the healing of the wound.

The teeth are retained in their sockets partly by the shape of the latter, as in a dried skull those which have their roots dovetailed in their sockets will remain *in situ*, whereas others will drop out by their own weight.

The chief bond of union, however, is their attachment by a strong membrane—the *alveolo-dental periosteum*—to the alveolus in which they lie, and it is the yielding of this membrane and the surrounding bone which allows of removal of a tooth.

In proceeding to consider the operation of extraction, it is desirable first to describe the instruments employed.

Formerly one instrument, named the key, was largely used, but this had grave objections, the chief of which were :

1. It was not accurately adapted to each tooth, and, therefore, touching only at a few points, acted mostly like a cutting instrument, either slipping off from or fracturing the crown.

2. When once applied to a tooth, the force exerted could only be in one given direction, and this might happen to be that in which the greatest resistance was offered.

3. The fulcrum of the instrument was applied on a soft tissue, the gum, which was mostly bruised, or sometimes lacerated.

The credit of introducing forceps adapted to the necks of every tooth is due to the late Sir John Tomes. The forceps is a modified pair of pincers, and consists essentially of the same parts—viz., a pair of blades or jaws with handles, which meet and cross each other at the hinge; each half becomes a lever of the first order, having its common fulcrum at the hinge. The instrument should be of excellent steel, and the blades or grasping portion so tempered as to slightly bend, rather than break, if any unusual force be encountered.

Besides being made to fit accurately to the neck of the tooth for which the instrument is constructed, they should be thin and sharp at their edges, so as to detach the gum from the tooth, and enter, when desired, between the root of the tooth and its alveolus. The blades should not be nickel-plated, as it adds no strength, and is liable to chip off, especially at the points of the blades, and a finer blade of polished steel is more desirable.

When closed upon a tooth, the blades should rest parallel with its neck for some short distance, not merely touching with their edges, and be quite free from impinging upon the crown. The blades should be no longer than is absolutely necessary, as power is thereby lost, the long blades often bending upon the neck of a very firm tooth instead of moving it.

In the construction of the hinge care should be exercised, not only that it is strong, but that it is not liable, when closed, to include portions of the lips, tongue, or cheek.

A slight amount of *lateral movement* in the hinge is advantageous, as no two teeth are exactly alike, and this

will allow the blades to adapt themselves more accurately to any given tooth.

More recently tooth forceps have been constructed in which the blades take apart for cleanliness, but beyond this advantage they have not met with much favour.

In constructing the adapted forceps, it is usual, after forging and fitting the blades as nearly to the required shape as possible, to fit them still more perfectly by applying them to the neck of a normally formed tooth coloured with pigment; the spots marked by the pigment are cut away, and the process continued until an almost perfect adaptation is attained, after which the blades are tempered.

Thus constructed, the blades should accurately fit upon the external and internal surfaces around the neck of the tooth; but as these do not always bear the same relative position to each other, the small amount of play at the hinge, as mentioned above, is useful in allowing the blades to accommodate themselves to this departure.

The handles should be strong, broad, and roughened, but not deeply serrated, as this will make cleanliness more difficult. The handles should be long enough to afford a firm grasp, but no more, for although length in the handles gives greater leverage, they make the instrument cumbrous, and interfere with delicacy of movement.

In employing the forceps, the operation of tooth extraction may be divided into *three stages*:

1. The application of the forceps to the tooth.
2. The destruction of its membranous connexions and dilation of the socket.
3. The removal of the tooth from the socket.

In the *first stage* the instrument should be taken in the palm of the hand, the blades pointing upwards or downwards, according to the jaw operated on, the thumb being

employed as a stop or regulator to govern the amount of separation of the handles, and consequently of the blades (Figs. 4 and 5).

In applying the forceps to the teeth, it is well first to adapt the blade to the side most obscured from view, and then to close the other blade upon the opposite side, but only so lightly as just to touch the tooth at the point of its connexion with the gum. This done, the thumb is now gradually withdrawn, and steady but forcible pressure made in the direction of the root of the tooth.

The force employed should be *regulated* by the amount of resistance experienced, commencing gently and increasing, as the case demands, and often accompanied to advantage by a very slight rotatory movement.

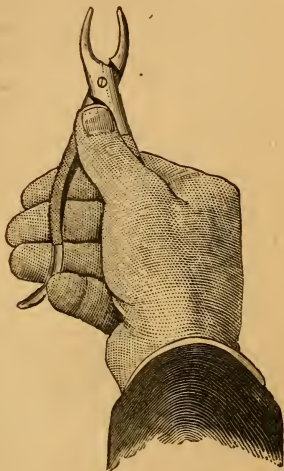


FIG. 4.



FIG. 5.

Experience will enable the operator to tell when this has been accomplished to the proper extent. The tendency in

a beginner, however, is not to force the blades sufficiently up the root of a tooth, and so to obtain only an edge-to-edge contact of the blades with the neck of the tooth, with the probable result of fracture of the tooth at this point; on the other hand, when the tooth is already loose, and especially if one with a single root, there is no need to push the blades up the root to any extent, and so doing only causes unnecessary pain.

The operator must judge as he progresses how much force is required, commencing gently, but continuing to increase the force until the object in view—viz., a firm grasp of the tooth—is obtained.

Perhaps more *judgment* is required in this portion of the operation than in any other, and it must be admitted that, if it be unskilful to use unnecessary force in obtaining a firm grasp, it will prove more unfortunate to err on the other side, and cause fracture of a tooth by employing too little. The tooth being grasped at the right spot, it must be retained by a force sufficient to prevent the instrument from slipping, but not so great as to endanger the somewhat frail object. Then the *second stage* of the operation, the severing of the tooth from its membranous attachment and dilation of its socket, is commenced.

This will consist in either a slight rotatory movement in the long axis of the tooth, as in the case of one having a conical root, or an inward and outward movement—i.e., at right angles to the mesial line of the dental arch—when the root is not conical, or there are two or more roots.

In making these movements we should follow certain general directions to be presently mentioned; but if we fail with moderate force to cause the tooth to yield, we may employ the force in other directions, gradually increasing it as we find our efforts availing.

The yielding of the alveolo-dental membrane and surrounding bone of the socket gives a sensation which we can readily perceive, and when it is sufficiently severed, and the socket dilated, we commence with our movements of detachment those more truly extractive, the *third stage* of the operation.

Judgment must be exercised here, too, for if the extractive force be put on too soon, great resistance will be experienced, and fracture of the tooth liable if the extractive force be continued; if put on too late, much unnecessary pain is inflicted. Error in the former alternative is likely to be attended with the unwelcome exhibition of portions of the alveolus. The extractive force should, as a rule, be exerted chiefly in the direction of the long axis of the tooth; but it is a rule with many exceptions.

The skilful operator will judge in what direction the loosened tooth is coming most readily, and in the direction of least resistance he should exert the traction. It is in this respect that the forceps is so superior to the key or other instruments—viz., in its enabling the operator to vary the direction of the force that he employs.

Having described the mode of applying the forceps in general, we now proceed to explain its *application* in the case of individual teeth, and must, in so doing, take it for granted that the reader is conversant with dental anatomy, and fully acquainted with the forms which the teeth in man present.

He must know that horizontal sections of **upper incisors** and **canines**, made at or a little below their necks (Fig. 10), present an almost circular form, the anterior and posterior aspects of which will be arcs of a circle, the anterior a rather larger one than the posterior. The blades of the forceps must be constructed to correspond to such forms, and to

cover when applied rather more than a third of the circumference of the tooth grasped.

Should the blades of the forceps used be too narrow, there will be a tendency for the blades to swing round the root without moving the latter when rotatory movements are applied.

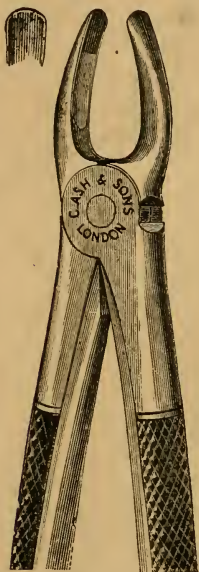


FIG. 6.

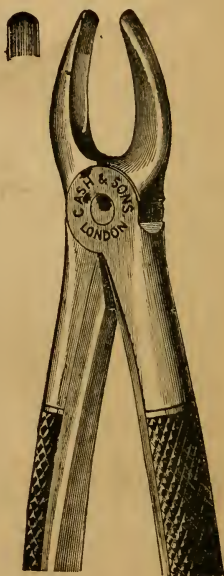


FIG. 7.

In the perfect instrument the inner blade should represent a less obtuse angle with the inner handle than the outer blade does with the outer handle ; in accordance with the form presented by the roots of these teeth, however, the difference in angle required is so slight that the blades are generally made similar in this respect, which in practice is perhaps an advantage (Fig. 6).

Whilst the same instrument may be employed for all the above teeth, a pair with narrower blades are desirable when small *lateral incisors* have to be dealt with (Fig. 7). The operation of extracting these teeth is thus performed : The patient should be seated and facing a good light, his head supported and roughly on a level with the operator's shoulder, and slightly extended. This position will be found convenient for all the upper teeth. If a proper dental chair be not at hand, a large arm-chair, provided with a cushion, to raise the body so that the head may recline steadily on the top, will answer sufficiently well.

If such a chair be not procurable, the following may be adopted : The patient is seated on an ordinary chair, whilst a second chair is placed at the back. On this latter the operator firmly places his left foot, and covering his knee with a towel, makes it a soft but firm support for the patient's head.

In applying the forceps to the teeth in question, upper incisors or canines, the operator should stand rather in front, and on the patient's right side, placing the first finger and thumb of the left hand on either side of the alveolar process surrounding the tooth—or, if preferred, use the thumb of the left hand for raising the lip—whilst the fingers of the same, resting upon the patient's forehead, afford steadiness to both patient and operator. The first method has the advantage of affording some knowledge of the yielding of the tooth and socket to the force applied.

The forceps, held as before directed, should be applied to the neck of the tooth, to its posterior surface first, and then closed gently upon it by the thumb being withdrawn. The instrument is now forced upwards in the direction of the long axis of the tooth until the edge of the alveolus, or, if the tooth be much decayed, a point beyond, is reached. As a rule, at least *a third of the root* should be in the grasp of the forceps.

EXTRACTION OF TEETH

The tooth being firmly grasped, a slight rotation in one direction is attempted ; but if much resistance be encountered, the rotatory movement is reversed, and if still

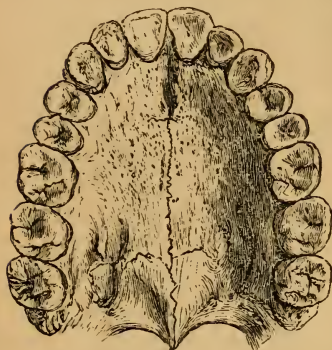


FIG. 8.—Teeth of Maxilla.



FIG. 9.—Teeth of Mandible.

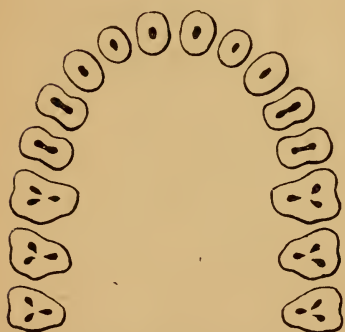


FIG. 10.—Showing Transverse Sections of the Teeth of the Upper Jaw (Maxilla) made at their Necks.

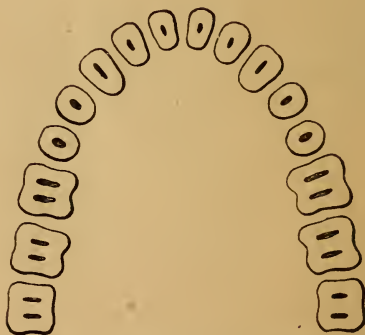


FIG. 11.—Showing Transverse Sections of the Teeth of the Lower Jaw (Mandible) made at their Necks.

resisted, it may be exchanged for an inward or outward one—*i.e.*, to and from the centre of the palate—coupled with a return to the rotatory. As the tooth begins to

yield from its attachments, the force may be gradually changed to a downward one in the direction of the long axis of the tooth; but it should be steady and guarded, inclining to the direction in which the tooth seems the most willing to yield.

Not infrequently an upper incisor will shoot from its

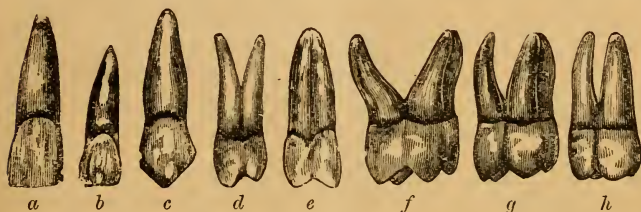


FIG. 12.—Permanent Teeth of the Left Side of the Upper Jaw (Maxilla).

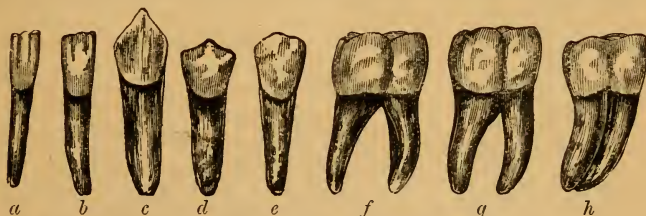


FIG. 13.—Permanent Teeth of the Left Side of the Lower Jaw (Mandible).

a, Central incisors; *b*, lateral incisors; *c*, canines; *d*, *e*, premolars; *f*, *g*, *h*, molars.

socket, owing to its root sliding along the double-inclined plane formed by the blades of the forceps, an occurrence not always possible to avoid, but one which we should do our utmost to prevent, as the tooth may disappear into the throat, or even larynx, under such circumstances; and some indication that a tooth is likely to suddenly shoot out is often gained by the fingers on either side of the alveolus, which, at the same time, may prevent such a tooth from falling into the mouth. More force will be

necessary in the removal of the canines than in that of the central incisors, and more in the case of the latter than in that of the lateral incisors.

We now pass on to the **premolars of the upper jaw**, sections of which at their necks (Fig. 10) are of a less circular form than is that of the teeth we have just considered, and instead of having an almost conical root, have a somewhat flattened one, the teeth being broadest between their external and internal surfaces. In the place of one root there may be two, or rarely three, this variation being more common in the first than in the second premolar (Fig. 12, *d, e*).

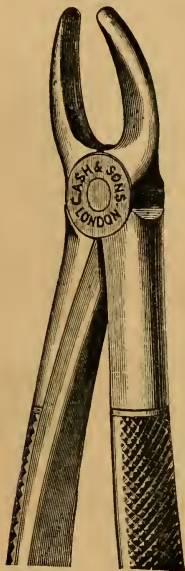


FIG. 14.

For these teeth we must have an instrument the blades of which are segments of the circles presented by the external and internal surfaces of these teeth at their necks, and for all practical purposes segments of the same circle will suffice, otherwise we should require a pair for each side of the mouth, as the handles are bent at an angle with the blades, to prevent the former from pressing against the lower lip during the operation. The breadth of the blades should be about the same as in the instrument for the central incisors and canines (Fig. 14).

The operator assuming much the same position as that just described, which is generally best suited to the removal of all the upper teeth, the instrument is applied and forced upwards as before directed. The severing movements must be accomplished by force exerted to and from the

palate, and preferably in that order—*i.e.*, first inward towards the palate, followed by a more forcible movement in the opposite direction, rotation in the case of the upper premolars being out of the question: their flattened roots, and the circumstance of their sometimes having two roots, would offer great resistance to such movement. As the tooth yields the extractive force may be commenced, and in the line of the long axis of the tooth, or varied, as resistance may indicate; and with it at times a slight shaking movement of the wrist may be advantageously combined.

Where the mouth can be opened wide, and the necessary inward movement of the instrument not likely to be impeded by coming in contact with the lower lip, a *straight* pair of forceps may be used for the first or even the second premolar.

The **molars of the upper jaw** present on section at their necks a more varied figure than the foregoing—*viz.*, in the external surface being a segment of two circles united at one extremity, of which the anterior is rather the larger, whilst the internal surface represents the segment of a circle much larger than either (Fig. 10).

In conformity with these circles must be the blades of the instrument, which are broader and somewhat stronger than those already considered, as should be the instrument generally; it will also be desirable to have the blades at a greater angle with the handles than in that last described (Figs. 15 and 16).

In addition to this angle, some prefer also a *curve* in the handles, the convexity of the bend being towards the roof of the mouth when the instrument is employed. A fault is frequently made in the construction of upper molar forceps, in that the inner or palatine blade is generally too concave, whereas the blade should be nearly straight, or even slightly everted towards the tip, in conformity with the root it grasps.

In removing a tooth of such dimensions and resisting form as an upper molar, we must be prepared to exert a larger amount of force than upon smaller teeth, and this especially in grasping them, when a very slight rotatory movement accompanying the forcing upwards of the instru-



FIG. 15.



FIG. 16.

ment will often prove advantageous. From the of the roots, it is apparent that only an inward and movement is feasible, commencing with the for. not, however, to be persisted in until some m effected, for, should this not come fairly readi outward movement is to be adopted, and w moderate amount of force, exerted also in the do. direction, often effects the complete removal of the too.

Generally, however, the lateral movements have to be repeated before the truly extractive ones can be attempted, and a slightly rotatory movement when the tooth is fully brought outwards will frequently more readily disengage it from the socket.

Here we have, besides the strong membranous attachments, to overcome the *dovetailing* of the roots and alveolus, consequently the latter must be dilated in most cases; fortunately they are, in the recent state, soft and moderately yielding.

The **second molar** may be removed precisely in the same manner and with the same instrument as the first; generally more readily, as the tooth is not so large nor its roots so divergent (Fig. 12, *g*).

The **third molar** of the same jaw has the two external circles at its neck so feebly pronounced, that an instrument both blades of which are segments of one large circle will be found well adapted for such teeth, and may be a greater for either side. If pre-

described, however, a similar instrument to that used for the

In addition, second molars may be employed, but in either handles, handles ought to form a considerable angle with of the m^{os}, otherwise it will be difficult to adjust them frequently and to allow of the extractive force taking in that the direction of the vertical axis of the tooth whereas t^h

except from the inaccessibility due to their position, the ^{first} upper molars are not, as a rule, difficult teeth to remove;

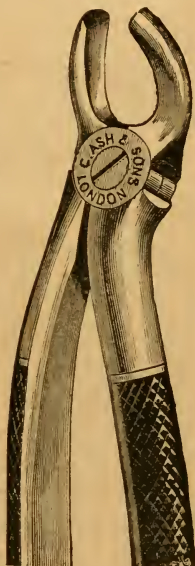


FIG. 17.

their roots, if not agglutinated, are generally but slightly divergent (Fig. 12, *h*), and the bone in which they are placed is *soft and spongy*. From the direction of their long axis, the movements of detachment and removal may be combined in an outward and downward one from first to last, it often being necessary to make the latter considerable; indeed, a circle passing from the crown of the tooth downwards, outwards, and upwards in the direction of the zygomatic process would represent an exaggerated curve, corresponding to that which the root of the tooth often assumes in its alveolus.

When we operate upon the teeth of the *lower jaw*, the patient may be conveniently seated in an ordinary easy-chair, provided there is some support for his head, and that his lower jaw is roughly on a level with the operator's elbow; the patient's head should be in a line with the body, and his jaw depressed, this position being the most advantageous both for admitting light and permitting the operator's movements.

As horizontal sections of **incisor teeth of the lower jaw** at their necks represent an ovoid figure, flattened laterally, the anterior and posterior surfaces of which are segments of a circle much smaller than that presented by the upper incisor teeth (Fig. 11), the blades of the instruments to be employed for their removal must be narrower, and arcs of a smaller circle, than in the case of the upper incisor forceps, and in relation to the handles nearly at right angles to the latter, so as to prevent the forceps from striking against the upper teeth while the tooth is removed (Fig. 18).

In employing the instrument, the operator should stand on the right and rather in front of the patient, steadying the lower jaw with the fingers of the left hand, whilst the thumb depresses the lower lip, rendering clear to view the teeth upon which he is looking down; or the thumb may

be placed below the jaw, with the first and second fingers in the mouth, on the outer and inner aspects of the alveolus respectively.

The instrument is well pressed down on the neck of the tooth, and the severing or detaching movements, which should be inward and outward, cautiously performed. They will be found to yield most readily in the outward direction, in which, combined with the upward direction, the final extractive force should be exerted.

For the **lower canines** not only should the blades of the instrument be somewhat broader, but they should represent segments of a larger circle; still, in practice, the same as that suitable for the incisors is found to answer very well.

The severing movements, as suggested from a sectional view of their roots, must be in the same directions—viz, to and from the centre of the mouth—but they will require more force in their removal than the incisors usually do.

In removing the canines of the left side, the operator should stand almost in front of the patient, or the patient's head may be turned towards the operator.

For the **premolars of the lower jaw**, a similar instrument to the last may be employed, or forceps, having the blades at a right angle to the handles, when the latter assume a position parallel to the alveolar ridge (Fig. 19).

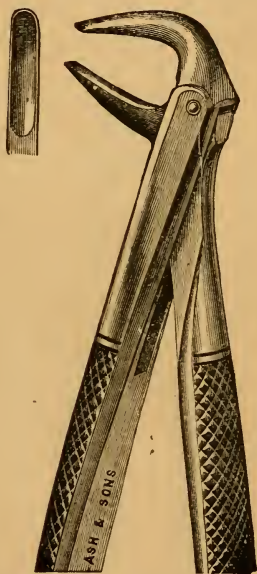


FIG. 18.

In using the latter form of instrument, the handles should lie above and parallel to the dental arch, and the blades embrace the tooth on either side. It is more a matter of custom as to which of these two forms should be used, but under certain conditions—viz., premolars presenting inside

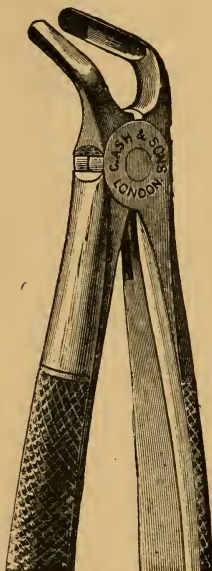


FIG. 19.

the dental arch, with their crowns directed inwards towards the tongue—this latter form of instrument is sometimes very useful in allowing sufficient inward movement without the handles of the forceps impinging against the upper teeth, and also in patients who are unable to open their mouths wide. On the other hand, the advantages of the hawk's-bill pattern are—

1. The arm is more free to apply the necessary rotatory movements than when held close in against the chest, as in using the straight form of instrument.
2. A clearer view of the tooth and surrounding parts is obtainable throughout the operation.
3. The alveolus can be more easily embraced by a finger on either side, and so form a safeguard from the forceps slipping or the tooth becoming dislodged from their beaks.
4. The head can be kept steady and better under control, especially when operating on the patient's right side.

In using these forceps, which we may term the hawk's-bill or side forceps, the operator stands in front and on the right side of the patient when removing a left tooth. This position is preferable to standing in front and on the left

side, as it will save the operator from having to change his position when removing teeth on both sides of the jaw.

In removing a right lower premolar, the operator stands behind and slightly to the right of the patient, with his left arm passing round the patient's head and his thumb and first finger embracing the inner and outer side of the alveolus respectively, the remaining fingers supporting the jaw, which should be well depressed on to the chest, both for steadiness and for allowing as much light as possible to pass into the mouth.

Occasionally it is more convenient, and obviates a change of position, to remove the right premolars from the front.

In operating with straight forceps on the right side of the mouth, the best position is to stand almost in front of the patient, whilst for the left side a position at the back of the patient, bending over towards his head, is recommended, in both cases employing the finger and thumb of the left hand for separating the lips and tongue from the gums, enabling him to see clearly where to apply the instrument and avoid opening the blades too widely; the jaw at the same time must be supported with the remaining fingers spread out under the chin, and the thumb, if necessary, employed to press the forceps well down into position.

Sections of lower premolars at their necks present an almost circular form, and their roots are generally conical (Fig. 11).

The forceps should be firmly pressed vertically downwards in the direction of the tooth, and the severing process attempted by a slight rotatory movement, first in one direction and then in the opposite, the movements being those of adduction and abduction at the wrist-joint, combined with a slight amount of supination, pronation, extension, and flexion. It is generally advisable to commence with rotation towards the operator, or abduction, if it

happens that detachment is felt after the first movements ; then force applied in a direction upwards and a little outwards (extension of the wrist) will remove the tooth.

The lower premolars are, however, very uncertain teeth to deal with, occasionally parting from their surroundings

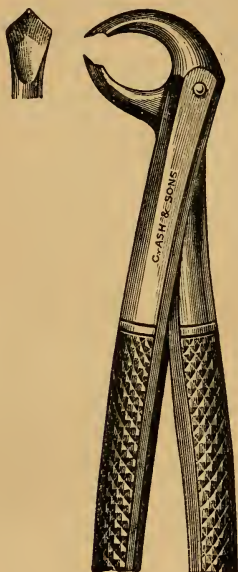


FIG. 20.



FIG. 21.

with but little persuasion, yet at times presenting very great resistance. We must therefore apply our rotatory force with discretion, changing it for an inward and outward one, or even combining the two, rather than risk too great a force.

The roots of these teeth, normally conical in form, and eminently suitable for rotatory movements, are very liable to be curved or twisted, or to have enlargements at their

extremities, thus opposing obstacles to such and other movements for their detachment ; and very often, also, when they are detached from their immediate surroundings, they are yet dovetailed into their alveoli, from which they may, if care be not exercised, come away very suddenly, causing the instrument to strike against, and perhaps damage, the teeth of the upper jaw ; but this is more liable to occur in extraction of the lower molar teeth.

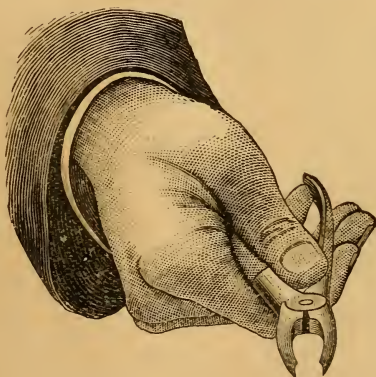


FIG. 22.

The Lower Molars.—As in the case of the lower premolars, so in that of the lower molars, two forms of instrument are employed—*i.e.*, those which are applied from the front of the mouth, and those which are applied from the side—and here, as in the case of the lower premolars, it is more a matter of custom as to which form is preferred (Figs. 20, 21, and 22).

A horizontal section of a lower molar tooth at the neck shows both its external and internal surfaces, of much the same form as the external surface of the first upper molar—*viz.*, two segments of a circle touching each other at one extremity, of which the anterior segment is the larger.

The blades of the instruments must, therefore, be made to correspond in like manner; and, in order to insure the greatest accuracy, there should be an instrument for each side of the mouth. Practically, however, the difference between the sides of the tooth is so small that one instru-



FIG. 23.

ment may suffice, provided the hinge possesses a little play. There are two roots placed anteriorly and posteriorly, flattened antero-posteriorly, and curved slightly backwards. The anterior canal is usually flattened in correspondence to the shape of its root, whereas the posterior is circular.

There is a tendency in the construction of lower molar forceps for the blades to be made too concave, so obtaining only an edge grasp of the tooth, instead of following down its roots and procuring a larger surface of contact; this excessive concavity of the blades produces a blunter beak to the instrument, necessitating more force in its application to the tooth than where the blades are nearer parallel, and likewise increasing the chance of fracturing a frail tooth.

A similar fault has already been pointed out in connexion with upper molar forceps.

The angle between the blades and handles should be nearly a right angle, so that the latter are clear of the dental arches throughout the manipulations.

For hollow molars, especially those associated with bulbous crowns, a useful form of instrument is that shown in Fig. 23.

For the removal of third lower molars, and occasionally for the more anterior ones, when the mouth cannot be widely opened, these forceps are made with a curve in the blades, the concavity of which looks forward. These have

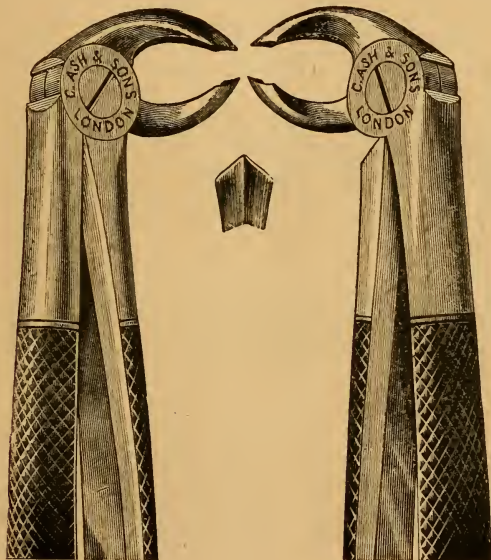


FIG. 24.

FIG. 25.

the advantage of requiring less space for their introduction ; but the disadvantage is that the blades are not so well under control, and there is more difficulty in applying the necessary force in the correct relation to the roots of the tooth. It likewise necessitates a change of instrument when operating on the two sides of the jaw.

Forceps with this curve in the blades are also made for the premolar teeth and molar roots (Figs. 24, 25, and 26).

In using these forceps the operator should stand in the same position as that recommended in the case of the lower premolars, employing the left hand in the same manner.

Slight inward movement may first be attempted, but the tooth will generally yield more readily in the outward direction, where the alveolus is less thick.

Anatomically these movements are those of flexion and extension at the wrist-joint, accompanied with abduction

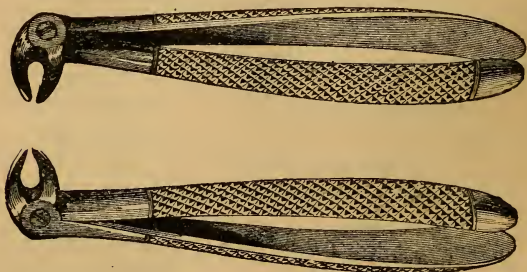


FIG. 26.

and adduction of the arm respectively, to give a longer range of movement. A slight amount of pronation accompanies the flexion, and likewise a slight amount of supination the extension.

The raising of the tooth is an exaggeration of the extension with the arm fully abducted.

The two large and dense roots, anterior and posterior, especially of the first lower molars, often occupy more space than does the tooth at its crown, where it is in contact with its neighbours. To raise it vertically, without injury to the latter, would be impossible; and, where the roots spread to any extent, the tooth becomes locked, necessitating the continuance of the lateral movements in

order to dilate the alveolus, and varying them with extractive force in a direction considerably outwards, but taking every care that the instrument in coming upwards does not strike and injure the upper teeth.

As in the case of the upper molars, a slight rotatory movement when the tooth is fully brought outwards will often more readily disengage it from its socket.

On comparing a horizontal section of a **lower third molar**, made at its neck, with a similar section of a first or second molar, it will be observed that the depressions on each side marking the union of the two roots are much less distinct; the blades must therefore be adapted to such forms.

In making the lateral severing movements, we shall generally experience great resistance, the cause of which will be evident if we examine such a tooth *in situ* by removing the external alveolar plate of the mandible. When it is thus exposed, it will be noticed that the roots incline backwards—*i.e.*, towards the angle of the jaw—a curving which is seen to increase from the first to the third molar tooth. The greater such a curve is, the greater, obviously, will be the resistance to lateral movement, as a larger surface is impinged upon; also the outer alveolar plate tends to become thicker in passing from the symphysis to the base of the coronoid process, which latter may be said to divide and embrace the molar and premolar region by its external and internal oblique ridges.

The form of the curve also indicates the direction in which such a tooth will most readily yield to force—*viz.*, upwards and backwards, towards the coronoid process.

Such a movement is almost impossible to effect with the forceps, but it is the precise one which an instrument—virtually one half of a pair of forceps, the *elevator*—can readily effect.

This instrument is most useful in removing lower

third molars, especially when the second molars remain *in situ*.

The foregoing instructions are tabulated below, and, after carefully studying the text, will be easily followed.

Teeth of Upper Jaw.

PATIENT SEATED RAISED, AND WITH HEAD SLIGHTLY EXTENDED.

Teeth.	Roots.	Forceps.	Detaching Movements.	Operator.
Incisors and canines.	One conical.	Fig. 6.	Slight rotation, or inwards and outwards.	Right side and rather in front.
Premolars.	One or two flattened laterally (external and internal).	Fig. 14.	Inwards and outwards.	Right side and rather in front.
Molars, first and second.	Three roots (two external, one internal).	Figs. 15, 16.	Inwards and outwards.	Right side and rather in front.
Molars, third.	Three roots (two external, one internal; often agglutinated).	Fig. 17.	Inwards and outwards.	Right side and rather in front.

Extraction of Roots of Teeth.

Thus far it has been taken for granted that the teeth on which we have been operating are fairly strong ones, not diseased or injured much below the level of the gums. When teeth in the latter condition present themselves, our instruments, as well as our lines of operation, must be somewhat modified.

The instruments must for such conditions have their

blades slighter, also more pointed and sharper at their extremities, to enable them to obtain a secure hold, and to readily divide much of the membranous attachments and penetrate into the alveoli, often to a considerable extent.

Teeth of Lower Jaw.

PATIENT SEATED AT ORDINARY HEIGHT, HEAD IN VERTICAL POSITION.

Teeth.	Roots.	Forceps.	Detaching Movements.	Operator.
Incisors and canines.	One, flattened laterally.	Fig. 18.	Inwards and outwards.	Almost directly in front.
Premolars.	One conical.	Fig. 18 or Fig. 19.	Slight rotation, or inwards and outwards. Slight rotation, or inwards and outwards.	Behind for right side, in front for left. In front for right side, behind for left side.
Molars, first and second.	Two (anterior and posterior).	Fig. 20 or Fig. 21.	Inwards and outwards.	Same as for premolars, according to instrument.
Molars, third.	Two (anterior and posterior, often agglutinated).	Fig. 20 or Fig. 21.	Inwards and outwards.	As above.

As regards the remainder of the instruments—handles, hinges, etc.—they may be of much the same construction as those for sound teeth, and the directions already given in regard to position of patient, operator, etc., are also applicable to them; but in making the severing movements we shall do well to exert the force more gently and more cautiously, preferring to lessen the danger of fracture by occupying a longer time. In the extractive movements, also, the same conditions should influence us.

It is advisable, however, where the strength of a tooth is doubtful, to employ an instrument which, in the event

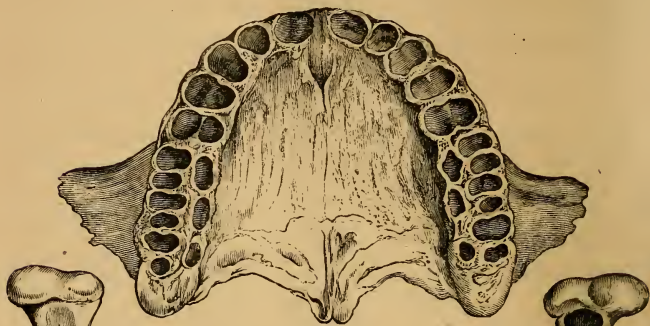


FIG. 27a.—Showing Sockets of the Maxillary Teeth.

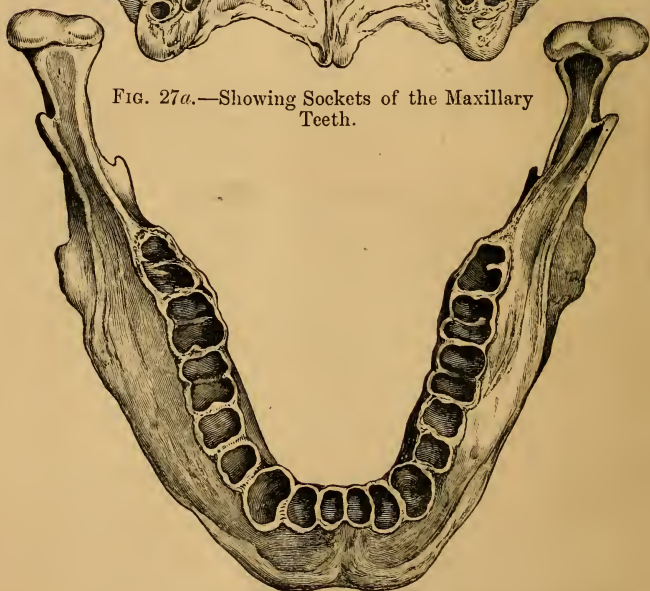


FIG. 27b.—Showing Sockets of the Mandibular Teeth.

of the tooth fracturing, would be also serviceable for proceeding with the removal of its root or roots.

As the blades of the instrument are constructed so as to

fit at the necks of the teeth, the same forceps may be used when this portion of the tooth remains intact as would be applied to the sound tooth itself; but should caries or injury have extended beyond this point, then instruments having thinner, sharper, and more pointed blades are to be preferred.

For removal of the roots of the upper incisors and canines, the forceps (Fig. 28) must be well pressed up, and care exercised that they are neither too widely open nor too closely shut. The latter is the error generally made by a beginner, especially where there is no portion of the tooth

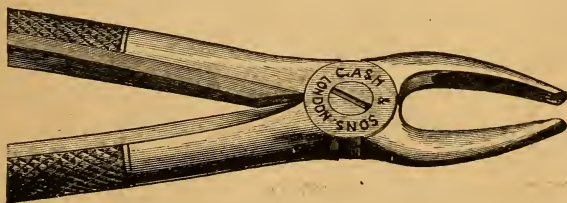


FIG. 28.

visible above the gum, or only a portion of one side left to guide him, resulting in one or both blades of the instrument being forced upon the root itself.

The direction of the root or roots being ascertained or allowed for—and if a knowledge of dental anatomy be essential to ensure a good extractor of teeth, it becomes of imperative necessity when hidden roots are operated upon—the instrument is forced upwards in the direction of the long axis of the root, this being often much assisted by a slight rotatory movement as well. The amount of pressure necessary will be determined by the resistance offered, and the extent to which the disease has advanced. At times we find the roots of these teeth so hollowed out, that but little more than a shell-like covering remains.

In these cases it is essential to press the blades of the forceps cautiously well up on to the root of the tooth, so that about two-thirds of the root below the gum are grasped by the forceps, and to err, if anything, in having the blades of the forceps open a little too wide, gradually closing them on to the root when the blades are pressed up sufficiently far.

Even if a small portion of alveolus is included on either side, it will tend to act as a splint in keeping the hollow root intact, whereas to err in not opening the blades sufficiently wide would be fatal in crushing up the root.

These precautions apply particularly to those cases where the root cannot be definitely defined.

Some have advised filling such roots previously with gutta-percha, or a cement which sets quickly, and so rendering them less frail. This, however, produces a somewhat false solidity, and, if the above precautions are taken, will be rarely necessary.

At one time an instrument called the screw forceps, consisting of a conical screw placed between the blades of the instrument (Fig. 29), was advocated for such cases, but it is nowadays rarely seen; also an instrument terminating at one end in a conical screw, and having a plain straight shaft enlarged at the other end to give a grasp for the hand (Fig. 30). This was cautiously screwed into the interior of the root, and by its means the latter was removed.

Fortunately, in these cases of hollow roots the surrounding bony alveolus has already been to some extent absorbed and rarefied by a simultaneous osteitis, and so rendered soft and yielding that there is rarely difficulty in removing such roots.

Having secured a firm hold of the root in question, with a very cautious grasp, proceed gently to make the same

rotatory or other severing movements as the case demands, followed by extractive ones.

The **roots of upper premolars** require blades possessing the same characters as for those of incisors and canines, but with these blades set at a slight angle with the handles.



FIG. 29.



FIG. 30.

These teeth have often two slender roots, especially the first premolar, and by their divergence afford a less perfect grasp than in the case of a single and more conical root ; also, when grasped, the two roots frequently become detached, and moving one upon the other, cause the instrument to slide off them.

Forceps having fine and long-pointed blades may here successfully remove each root separately (Fig. 31).

Frequently **upper molars** are carious or fractured level with their necks, but having their root still firmly united to the remains of the crown.

Such a tooth roughly represents an inverted truncated cone, and the forceps used for the removal of such teeth are in fault in that the palatine blade is made too concave. On closing the forceps upon the root only an edge grasp can be obtained, the blade only touching at points.

The palatine blade should be nearly straight, so that on pressing the forceps well up on to the root, this blade lies

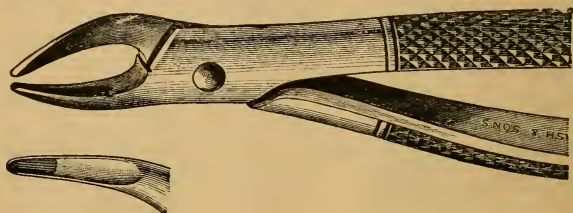


FIG. 31.

for some distance parallel with the palatine root, and ensures a larger surface of contact.

A further advantage is obtained in the ease in which such a blade can be pressed up into the socket.

Cutting forceps have been designed with the idea of separating such roots, having the inner or palatine blade of much the same form as in those last described, whilst the outer or buccal blade terminates in a vertical cutting edge, which, when closed, approaches within a short distance of the former (Fig. 32).

When employed, the palatine blade is first adjusted and then the outer closed upon it, generally in such application dividing a portion of the mucous membrane and the thin outer edge of the alveolar process. Increased pressure cuts through the two external roots, the sharp blade pene-

trating into the palatine root, which is generally brought away in the forceps, and the operation concluded by removing the separated external roots with fine root forceps.

However, such forceps are rarely needed, and the same end is frequently accomplished in using the ordinary upper molar forceps, or upper root forceps, with the additional advantage that by this means the three roots may be removed intact.

It is conceivable where, owing to the loss of the crown of an upper molar, the adjoining teeth have come

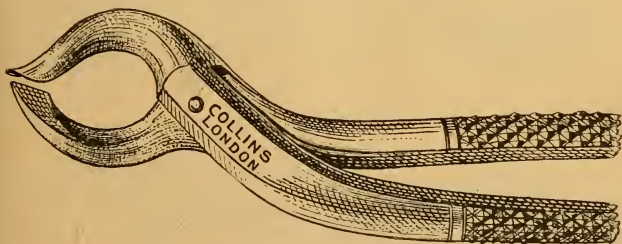


FIG. 32.—Upper Molar Splitting Forceps (Right).

together at their masticating surfaces, leaving a wedge-shaped space through which it is impossible to deliver the three roots intact, that by dividing the stump up into its constituent roots each may be easily and safely removed without endangering the neighbouring teeth.

Other varieties of instruments have been devised for the removal of such teeth as above mentioned. In one form the palatine blade is divided into two limbs, which grasp the palatine root on either side and prevent the instrument from slipping off the tooth (Stevens) (Fig. 33). Another form is similar in construction to the dividing forceps, but having a single tapering buccal blade prolonged to a point,

capable of passing between the buccal roots and obtaining a firm hold of a crownless tooth (Baly) (Fig. 34).

When, however, caries or injury has advanced to destruction of the whole crown, leaving the several roots barely attached to one another, or insufficiently attached to remain intact during the extractive movements, the operation may be readily accomplished with root forceps, giving to the instrument a rotatory movement when each

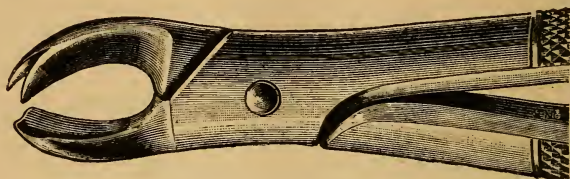


FIG. 33.

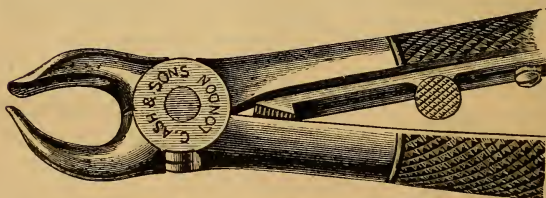


FIG. 34.

root is separate, but otherwise passing through the same extractive movements as in dealing with upper molars, except that the range of movement should be somewhat curtailed.

The **roots of upper third molars**, not generally divergent to the extent of first or second molars, are not, except from their position, very difficult to remove.

For removal of the roots of upper third molars an instrument, somewhat similar to that used for the roots of upper premolars, may be used, but having the blades bent up at a greater angle to the handles, and with the latter directed

backwards at about 1 inch beyond the hinge. The blades, when open, are nearly parallel with each other (Fig. 35).

This form of instrument was devised by Alfred Coleman. The same idea has since been carried out by introducing a middle piece or shaft to the instrument, the blades and handles of which are set at nearly rectangular

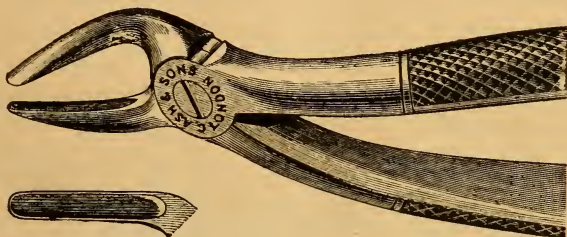


FIG. 35.

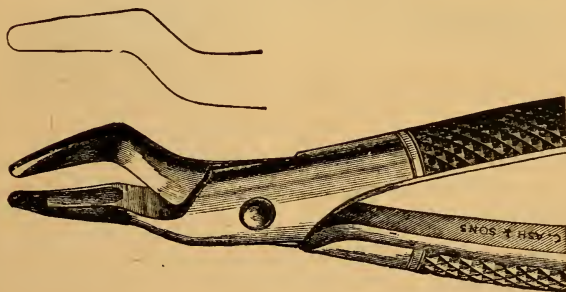


FIG. 36.

curves to this shaft (Fig. 36). This has the disadvantage of throwing the hinge further away from the blades, with consequent loss of power.

By either of these means an instrument is constructed the blades of which are in the correct axis for the removal of the root, and, at the same time, the handles are clear of the cheeks.

The same forceps may often be employed with advantage

for the other upper molars when carious down to the gum, for when firmly thrust up the alveolus, it seldom fails to bring away one, two, or all the roots at once.

For the roots of first molars an instrument with the blades at a less angle to the handles is preferable, and the latter may be either straight or curved towards their extremity (Fig. 37).

For the roots of second molars the choice lies between these two forms, giving preference to the less curved instrument when the mouth can be opened sufficiently wide and other conditions are favourable.

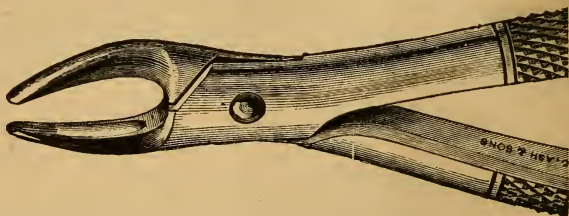


FIG. 37.

As a rule, when the roots of upper molars are separate, but yet in close contact, it is advisable to open the blades sufficiently wide to include the palatine and one of the buccal roots, the posterior for preference. In so doing, frequently both are removed together and the remaining root loosened, or one root will be removed with loosening of the other two:

By trying to pick out each separately, when the roots are close together, one blade of the instrument is liable to press on the surface of one of the remaining roots, especially when these are below the gum, and so prevent the instrument from passing down the alveolus and obtaining a firm hold. Subsequent hæmorrhage may make it difficult to afterwards define the remaining roots, whereas,

if, in the first instance, the blades are widely opened to the outer limits of the stump, and pressed up in this position, any subsequent hæmorrhage will not materially interfere with the removal of any root left behind, as, their outer limits having been defined, we are given the area in which to seek the remaining root or roots.

When upper molar roots are separate, a useful plan is to remove first the anterior buccal, then the palatine, and lastly the posterior buccal root, utilizing the empty socket, if necessary, in removing the subsequent root:

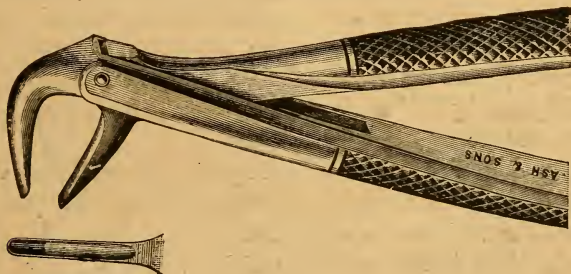


FIG. 38.

The palatine is generally the most concealed root, and the socket of the anterior buccal often forms a useful guide.

The anterior buccal root, when close up against its proximal tooth, requires forceps having the blades at a sharp angle to their handles to clear the tooth in front.

Roots of lower incisors and canines may be advantageously operated upon with forceps similar to those used when their crowns are intact, but for preference provided with slighter and sharper pointed blades (Fig. 38).

The same forceps may be used for lower **premolar roots**, or the straight pattern, if preferred, and the same movements conveyed to the instrument, when the presenting portion of root appears fairly sound, as in dealing with the teeth themselves.

When the root is carious to some extent below the gum, an instrument with slighter and sharper pointed blades will be more adaptable, and some have suggested the straight elevator for such cases.

A straight or curved elevator is often the only means of removing the apices of these teeth left behind after fracture, and the reason becomes apparent when observing how often the terminal portions of these roots are curved, precluding any grasp with root forceps, even if the latter were better designed for passing deep down into the socket.

Before considering the removal of the **roots of lower molars**, it will be necessary to mention an instrument frequently used for same; called the elevator, first described and figured by Bell in his work, to whom must be accredited its parentage.

The *elevator* consists essentially of two portions—viz., the blade and the handle—although an intermediate portion may be termed the shaft (Figs. 39, 40, and 41).

The blade is that portion which, as in the case of the forceps, is applied to the tooth, and some forms are constructed as if with the intention of fitting a root in its long diameter; but, as the elevator is rarely, if ever, applied in such a manner, the cup-like form which it sometimes presents is only a barrier to its effective employment, and also tends to weaken the blade.

The blade should be thin, about $\frac{1}{5}$ inch in breadth, flat, or but slightly concave on its anterior surface, and convexly rounded on its posterior surface, and from the latter to the former bevelled off and sharpened to a V-shaped point. The anterior surface may be finely grooved in its long axis, the posterior smooth, and the extremity kept sharp.

The handle should be fully $3\frac{1}{2}$ inches in length, roughened, and of sufficient width to comfortably fill the palm and afford a firm grasp.

The fulness of the handle is of great importance, as a very firm grasp of the instrument is required during the rotatory movements necessary in loosening a tooth; if the



FIG. 39.



FIG. 40.

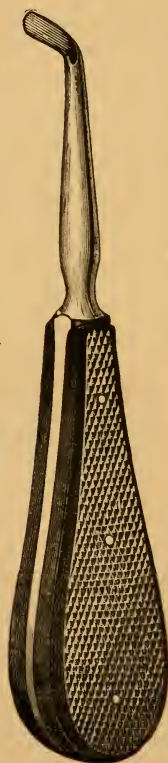


FIG. 41.

handle be slender, the palm of the hand will slip round it during these movements.

It is needless to say that the entire instrument should be made of metal, and, for preference, forged out of one

piece of steel, which can be subsequently lightened by hollowing out the handle from behind.

In operating, an elevator is used as a simple lever; it should be firmly grasped at the handle, and held somewhat like a dinner-knife, the forefinger of the right hand resting upon it about $\frac{1}{2}$ inch from the extremity of the blade. This not only gives steadiness, but also acts as a stop or guard, should the instrument happen to slip (Fig. 42).

The forefinger should, as a rule, be applied to the front and side of the blade, the remaining side of the blade and

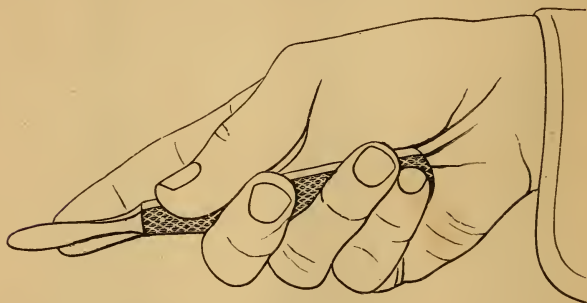


FIG. 42.

its point engaging the neck of the tooth. This is on the assumption that in each case we are applying the elevator to the anterior surface of the tooth.

For illustration, let us suppose that we are about to operate on a third molar of the right side of the lower jaw.

The elevator being held as before described, the operator, standing somewhat behind and leaning over the patient's head, separating with the finger and thumb of the left hand the cheek and tongue from the jaw, the point and side of the blade is introduced at the margin of the gum between the front of the tooth and its alveolus, inclining the point towards the apex of the root by raising the handle, then

driving the blade well down the alveolus, and finally fixing the same into the root by depressing the handle of the elevator. The latter is more easily accomplished by slight rotatory movements in passing the blade down the alveolus, which have the effect of separating the alveolus from the tooth, and so allowing the blade to reach further down on to the root.

When the blade feels fixed in the root, slight rotatory movements—*i.e.*, supination and pronation—combined with an upward one, effected by depressing the handle, will generally raise the tooth from its socket, and in the curve before mentioned—*viz.*, that of which its crown and roots form a segment.

In some cases these rotatory movements will have to be repeated several times, each time obtaining a grasp with the blade lower down the alveolus on to the root.

In the final stage of the operation the force must be directed almost directly upwards, and here every care must be taken to prevent the instrument from slipping backwards when resistance is no longer offered.

Throughout these manipulations the round part or back of the blade rests upon the margin of the socket or the neck of a contiguous tooth, either of which forms the fulcrum for the elevator or lever.

In the case of lower third molars, it not unfrequently happens that, when elevated from their sockets, they remain attached to the mucous membrane, which is firmly adherent to their necks, especially at their posterior surfaces, from which they must afterwards be detached by a sickle or hoe-shaped lancet, or scissors having curved blades. The elevator is employed in much the same manner for the other teeth, except that in the upper jaw, and especially for the roots of single-fanged teeth, it must be introduced in a more vertical direction.

The elevator is, however, rarely required for the removal of upper teeth, except sometimes in connexion with the temporary teeth, which will be considered later.

For upper third molars, or their roots, the elevator should not be employed, the force being exerted in the direction of the tuberosity of the upper jaw; this portion of the bone may be readily detached, and with it, what is more important, the hamular process of the internal pterygoid plate, possibly resulting in deafness on that side.

For detached roots of both jaws, elevators having the terminal portions of the blades at an angle to the handles may often be employed with great advantage. These are made in pairs for either side of the mouth, and according to which root is being dealt with (Figs. 40 and 41).

Having now described the three different forms of elevators in common use, it will be necessary to return to the removal of the lower molar roots, where such an instrument is often useful.

Roots of lower, like those of upper molars, may be found detached or united to their crowns.

When the roots are not firmly connected with the crown, root forceps are preferable, applied in the direction of one of the two roots, the more visible and stronger being by preference selected.

The ordinary movements for these teeth will frequently bring away both, or, failing to bring away more than one, the remaining root is afterwards in like manner removed.

If, after the removal of the first root, the second becomes obscured by subsequent hæmorrhage, or if previously concealed, a very useful way of completing the operation is to pass one of the curved elevators down into the empty socket, then through the septum and adjoining root until a firm hold on the latter is obtained, when, by gentle rotatory movements, combined with slight depression of

the handle of the elevator, the remaining root will be felt to become loose in its socket, and in most cases easily removed.

When the roots of the lower molars are much divergent, there will be a thicker septum of bone to penetrate with the elevator before the blade of the latter comes into contact with the remaining root, and increased resistance will be encountered in removing such a root.

This septum of bone is generally, but not necessarily, loosened at the same time, but in any case will be subsequently removed by absorption. It is sometimes more easy to dislocate the remaining root into the already empty socket by passing a curved elevator down behind the root, but little resistance is offered to its movement in this direction, and the elevator can often be applied to a firmer portion of tooth.

The elevator may be used in a manner different from the foregoing, especially in the case of loose and temporary roots—viz., by applying its point firmly against them and then pressing upwards, downwards, or laterally, as the case may demand.

Other instruments for the removal of roots of teeth have been devised and employed, but as they are seldom used, a description of them will only tend to complicate the subject.

As a general rule, if *a third or less of a healthy root* has been left behind, owing to fracture in removing a tooth, this portion may be safely, and is perhaps better, left.

Generally in these cases the end of the root is sharply curved, so that either this terminal portion or the alveolus itself must fracture, and probably the first mentioned is the least of the two evils.

Any attempt to remove a small portion of root deep in

the alveolus will not only be difficult, but accomplished only at the expense of injuring the surrounding bone. Where, however, there has been a chronic sinus or other local trouble connected with such root, it becomes imperative to remove the root entire, and this often becomes easier if delayed for a few days, when the resulting inflammation has both loosened and extruded the remains of the root.

In addition, the latter is not obscured by recent hæmorrhage.

I have recently designed lower root forceps, which, to some extent, meet these difficulties. The blades are long and slender, and meet at their points; at the same time the width across the nozzle or beak of the instrument is diminished, thus allowing the blades, when slightly separated, to be parallel and capable of being passed deep into the socket, with but little resistance or injury to the alveolus (Fig. 43).

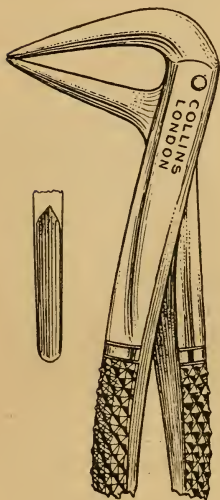


FIG. 43.

The diminished width of the nozzle, which is rendered possible by the absence of a crown, has been a decided gain, as the nozzle of the ordinary form of root forceps

tends to engage in the socket before the blade reaches the root, or can be opened sufficiently wide to clear its margins and obtain a firm grasp.

Sometimes, by previously packing the socket with gauze or wool, the remains of the tooth can be clearly detected on a subsequent visit.

No gauze or other material used for plugging should be left in the mouth for more than twelve hours without

renewing; if so it will become offensive, prevent healing, and possibly induce secondary hæmorrhage.

Extraction of the Temporary Teeth.

The temporary teeth are distinguishable from the permanent series by their smaller size, lighter and more transparent colour, and by the enamel terminating in an abrupt ridge at the gum margin, and so accentuating their



FIG. 44.—Showing Temporary Teeth *in situ*, with their Permanent Successors in Crypts.

neck; likewise, at a time when they could be so mistaken, their masticating surfaces will exhibit evidences of wear, and the teeth themselves be slightly loose. The above, in addition to their position and relation to other teeth in the dental arch, will suffice to indicate their nature.

Temporary incisors and canines are relatively broader and shorter than their successors.

First upper temporary molars have three cusps, two external and one internal, thus differing from the square four-cusped crown of a permanent molar (Figs. 44, 45, and 46).

The indications for the removal of the temporary teeth are somewhat different from those of the permanent series, and this difference is accounted for by the following circumstances :

1. The temporary teeth are only subservient for a short, although important, period during life.

2. The age of the patient during which the temporary teeth are functional.



FIG. 45.—Upper Temporary Teeth (Left Side).

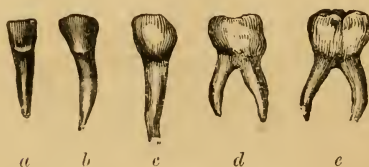


FIG. 46.—Lower Temporary Teeth (Left Side).

a, Central incisors ; *b*, lateral incisors ; *c*, canines ; *d*, *e*, molars.

3. The diseases requiring removal of teeth for their cure or alleviation are somewhat different in the earlier periods of life from those occurring later.

4. The fact that these teeth are to be followed later by more permanent ones, whose position, usefulness, and soundness depend to some extent on their predecessors.

5. The fact that the growth of the jaws and of the body generally is most active during the time at which the temporary teeth are functional, and that this growth

is to some extent dependent on their presence, and liable to be influenced in a favourable or unfavourable way, according to their condition.

Bearing the above circumstances in view, the following would be considered *indications* for the removal of the temporary teeth :

1. Temporary teeth which have become so loose as to be not only useless, but annoying to the tongue and lips, and liable to be dislodged at any time.

2. Temporary teeth require removal when they are impeding the eruption of their permanent successors, or causing the latter to deviate from their normal position.

3. Carious or injured temporary teeth giving rise to pain or swelling of surrounding parts at a time when their functional period is, or should be, nearly at an end.

4. In a fretful and nervous child, when to save an aching tooth would require a rather long and tedious operation, and when the child's health has evidently suffered from sleepless nights.

5. Temporary teeth in connexion with which there is an abscess, sinus, or other pathological condition, or where their necrosed roots have protruded through the gum and caused ulceration of the cheek or lips.

6. Temporary teeth causing or aggravating ulceration of the tongue, lips, cheeks, or other adjoining soft tissues, when the tooth or teeth in question are not readily amenable to other treatment.

7. Temporary teeth apparently the direct cause of enlargement of lymphatic glands, or where such teeth possibly act as a source of irritation to already diseased lymphatic tissue.

It must be borne in mind that in young children the lymphatic glands may be palpable without necessarily being diseased, and that up to the age of six or eight years the lymphatic glands are normally palpable and frequently the size of small dried peas.

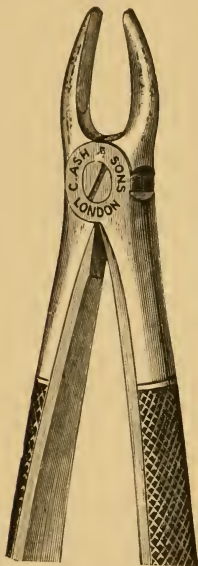


FIG. 47.

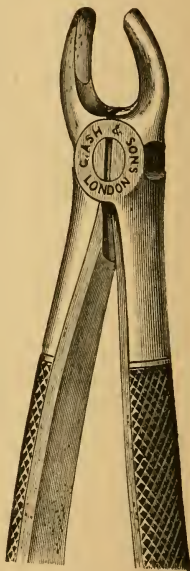


FIG. 48.

Extraction of the temporary teeth will be conducted upon precisely the same principles as in the case of the permanent ones, except that instruments on a smaller scale are preferable, and fewer will be necessary : a small, straight pair for the **upper temporary incisors and canines** (Fig. 47) ; for the same teeth in the lower jaw an instrument similar to that used for the permanent teeth, only lighter, and having the blades shorter and more slender (Fig. 38).

For the **upper temporary molars**, an instrument constructed much on the same plan as that for the permanent molars, only lighter, and with both blades as segments of a circle, will be convenient for either side of the upper jaw (Fig. 48).

For **lower temporary molars**, an instrument, smaller and lighter, but otherwise similar to that used for the permanent teeth, will be found useful (Figs. 20 and 21).

However, for first temporary molars, both upper and lower, root forceps are quite applicable for their removal; and the second temporary molars, both upper and lower, can be well removed with the respective permanent molar forceps.

A pair of very fine upper and lower root forceps forms a useful addition, especially for the separated roots of molar teeth, where, if too broad a blade be used, there is a danger of encroaching upon the erupting premolars, and either chipping their crown or loosening them (Figs. 31 and 43).

The movements of seizing, loosening, and removing will be the same as in the case of similar permanent teeth, as also the position of patient and operator, but *less force* in every way will be necessary.

Incisors and canines, both upper and lower, are generally removed without much difficulty. They occasionally yield with a snap, strongly suggesting a fracture of their root, but due in reality to their attachment to the surrounding bone. Their roots are more or less absorbed according to the period of removal, the position of their successors, and the condition of the teeth themselves—viz., whether containing live or dead pulps.

When the roots of temporary teeth become necrosed through gangrene of the pulp, suppuration around the root, or other causes, they frequently give rise to ulcera-

tion of the overlying tissues, and protrude, with a greater or less extent of their root exposed.

Probably, in most cases, the ulceration of the gum is secondary to the presence of the necrosed root, as the ulceration is generally strictly limited, and is due, no doubt, to its presence acting as a foreign body and to the pressure it exerts while being forced out of the gum by its successor.

These exposed roots of temporary teeth present almost invariably on the outer side of the alveolus of both upper and lower jaws, and are easily removed by a straight elevator passed between the root and gum, applying pressure in the line of least resistance.

If there be rather a thick band of gum overlying portions of the root, it is advisable to previously divide this by cutting down on to the root with a scalpel before applying the elevator.

Temporary molars are the teeth in this series requiring most care in their removal, as, having fine roots, much spread out, they are liable to be fractured unless the movements are very cautiously made, and the range of the same only gradually increased as the tooth becomes slightly loosened.

Should a root, or portion of a root, be left in, it can generally be easily picked out afterwards with fine bladed root-forceps, or sometimes, preferably, with an elevator, applied close up against the root, so as to avoid loosening or dislodging the underlying premolar.

A temporary root need rarely be left in if the proper instruments are at hand, as, if left behind, it is likely to divert a permanent successor from assuming its correct position in the dental arch.

For the removal of **retained temporary teeth** or roots, after the permanent successors have taken up their position in the dental arch, the same rules hold good.

Where a temporary tooth retains its position in the dental arch beyond the normal period, and there is no apparent sign of its successor, this tooth should on no account be removed, or else, perhaps, a permanent gap may be left, which would otherwise have been filled by this temporary substitute for many years. Where a permanent tooth is absent, the roots of its temporary predecessor are not so likely to become absorbed.

Some, however, have stated that when a retained temporary tooth is removed, its permanent successor, if present, will be more likely to erupt; but it seems doubtful if a sound temporary tooth would impede the normal eruption of its permanent successor, provided there are no mechanical difficulties in the way.

A set of instruments comprising six pairs of forceps, three elevators, together with a blunt probe, conveying tweezers, and a mouth mirror, would be all that would be required for most cases of extraction.

The forceps should consist of the following: upper molar forceps (right and left), lower molar forceps, upper and lower incisor forceps, upper curved root forceps, elevators (straight and curved).

Upper incisor forceps will be convenient for incisors, canines, premolars, and their respective roots.

Lower incisor forceps for incisors, canines, premolars, and their roots, together with the roots of lower molars.

Upper curved forceps for premolars, molars, and their roots.

Upper molar forceps for right and left molar teeth, one pair for each side.

Lower molar forceps for lower molar teeth of either side.

Elevators, two curved and one straight pattern, chiefly

for the roots of lower molar teeth, but occasionally for other purposes as mentioned above.

A blunt probe is necessary for defining the margins of roots, or determining their presence or absence.

Where the region of applicability of one pair of forceps overlaps that of another, as in the above list, the choice will depend upon the circumstances present.

All the above forceps may be well used for similar teeth in the temporary series, with the exception that the first temporary molars, both upper and lower, are often more adapted to root forceps.

Teeth may be erupted at, or even prior, to birth. I had recently to remove a lower incisor tooth in an infant a month old, as it had caused an ulcer on the under surface of the tongue, and given rise to a good deal of distress. The child was born with two lower incisor teeth, one of which had previously been removed by the medical attendant. The mother had been able to suckle the child without much discomfort or the use of a nipple-shield. Another child in the family was similarly born with two lower teeth, and the father of the children likewise presented the same condition at birth. The eight other children living were healthy, and dentition in them appears to have been normal.

These early teeth may be well formed or consist of but little more than a sharp calcified cusp, loosely attached to the mucous membrane, and can, in most cases where necessary, be removed with the fingers. In the case above mentioned, about half of the root of the tooth was formed.

CHAPTER II

DIFFICULTIES, COMPLICATIONS AND SEQUELÆ IN CONNEXION WITH EXTRACTION OF THE TEETH

It is now necessary to consider some of the difficulties, complications, and their sequelæ, which may occur during the extraction of teeth.

A very common difficulty is great resistance to our efforts on the part of the tooth, and judgment as well as skill will be taxed in deciding how much may be lawfully employed.

We may expect to find teeth of a yellowish shade, and somewhat worn on their crowns—especially in persons about middle age, and of wiry constitution—more difficult to remove than large, light-coloured teeth in younger persons.

The size of the crown will be no criterion, as the roots or their firmness may be out of all proportion to them.

A tooth, especially a first or second molar standing alone, will often prove unusually hard to remove, and generally more so if it be situated in the lower jaw, where the surrounding bone is more dense. Our judgment will often be severely taxed in such cases; but it may be well laid down as a rule that the practitioner, especially if a strong man, should never expend the whole of his strength on any tooth. The amount necessary to be exerted may be

great, but must be restricted within limits. It is extremely unpleasant to send a patient away with an aching tooth *in situ*, but frequently there is a cessation of pain in a tooth the removal of which has been attempted; and should the patient be seen a day or two later, the tooth will, in all probability, have become slightly loosened from inflammation set up as a result of the previous attempt at extraction, and yield to a moderate amount of force.

As, however, it is more desirable to complete the operation at the same visit, both from the patient's and practitioner's point of view, it will be advisable to obtain an anæsthesia which can be prolonged for several minutes if found necessary, and then to once more apply our force with care and judgment, firmly supporting the alveolus on either side.

These resistant teeth are generally fairly sound or present but little caries, and in the first attempt at their removal full molar forceps are naturally utilized. However, if root forceps are passed well up the alveolus, obtaining a secure grasp on one or two roots, according to the tooth in question, successful removal will frequently be effected; or, if fracture should occur, it will be more likely a separation of the tooth into its component roots than a transverse fracture across these. In the case of the former, the remaining root or roots are easily removed, whereas the latter may be a very troublesome condition to remedy if the fracture is low down in the alveolus.

Full molar forceps are not well adapted for obtaining a firm grasp on the roots of teeth, as mentioned previously.

Forceps have been devised for splitting up a tooth into its component roots, each of which is subsequently removed (Figs. 32 and 49). These may at times be found useful when dealing with resistant teeth, especially if exostosis be suspected as the cause. Personally, I prefer using root

forceps in the way mentioned above. It must not be forgotten that pathological conditions may be associated with the roots of such teeth, which preclude their removal by the ordinary methods—*e.g.*, odontomata.

The causes of great resistance in the removal of a tooth are partly in the conformation of the tooth itself—*e.g.*, the form and direction of its roots—and partly in that of the surrounding bone—*e.g.*, where this is thick and dense, as sometimes found around an isolated lower molar.

Occasionally a tooth may be slightly loosened in its alveolus without using very much force, but yet will resist

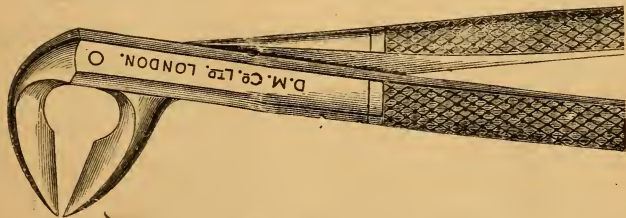


FIG. 49.—Lower Molar Splitting Forceps.

any further efforts in its removal. In such teeth the ends of the roots are frequently found clubbed and thickened from exostosis. Where, however, the exostosis only amounts to slight thickening, by repeating the movements suitable for loosening the tooth the alveolus will be dilated up sufficiently to allow of delivery of its roots.

In some cases it may be necessary to gouge away the alveolus or surrounding bone in order to remove a misplaced tooth, or the root of a tooth, where much enlarged or distorted.

Another condition occurring especially in the lower molar region, which gives rise to difficulty, is where a tooth otherwise firmly implanted stands well out above the gum, so that the latter is attached below its neck.

Here the difficulty arises more from the want of an instrument adapted to such a case than from any special difficulty attached to the tooth itself.

If ordinary lower molar forceps be used, the latter will impinge on the crown of the tooth before the blades are sufficiently below the gum to insure a firm hold, so that the strain occurs on a portion of the root unsupported by bone, and, consequently, is liable to fracture at this spot ; whereas if root forceps be relied on, the amount of tooth substance within the grasp of the blades is less, and so the strain on any one part is greater, likewise increasing the risk of fracture.

A similar condition occurs in connexion with an upper molar tooth, from loss of its opponent tooth, absorption of the alveolus, or other causes, the upper molar becoming extruded from its socket, exposing divergent roots ; for this condition the palatine blade should be constructed so that its terminal portion is slightly everted. A form of instrument adapted for such cases was devised by Alfred Coleman, and described in the following words :

“The outer blade is made like that for an ordinary molar tooth, but narrower, rather longer, and with the intercircular point more pronounced and sharper. The inner blade is also narrower, thinner, longer, and sharper, and, near its extremity, bent outward in the direction which the palatine fang takes.”

In removing such a tooth, and more especially when the palatine root is markedly divergent, the force should be at first directed inwards, as there is some liability of the instrument slipping off the root when moved in the opposite direction.

Teeth may, owing to abnormal formation of their crowns, be rendered more difficult of removal, no ordinary instrument being capable of adaptation to them ; and the position

assumed by teeth in regard to their neighbours may wholly prevent the employment of the ordinary instruments, or, at all events, in the usual directions.

This condition, the result of **crowding**, is not infrequently met with in the lower incisor region. An incisor

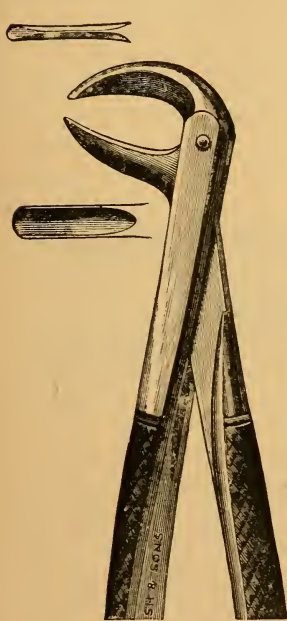


FIG. 50.



FIG. 51.

may be placed so directly before or behind other teeth that there will be no space in the former for the posterior blade, or in the latter for the anterior blade, to be applied.

To meet such cases, forceps having a very narrow posterior, or a very narrow anterior blade, are constructed

(Figs. 50 and 51); but, as these narrow blades are apt to nip off the crown, or split the root, it is often preferable to employ one of the ordinary root forceps, grasping the tooth laterally, and pressing the blades towards the alveolus at an angle to the crown.

For the corresponding condition of the upper jaw, similar forceps are constructed, but to these the same remarks apply as in the case of the teeth of the lower jaw (Fig. 52).

Upper canines placed outside the arch is a common misplacement, and may require removal of these teeth.

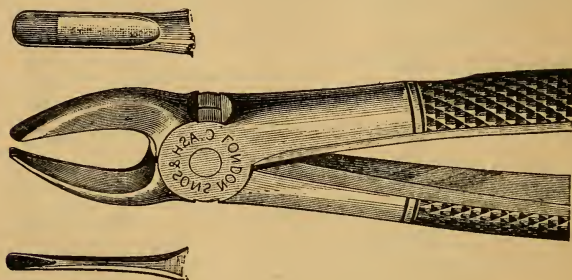


FIG. 52.

The blades of the forceps are best applied laterally to the tooth—*i.e.*, on their mesial and distal surfaces—being guided into this position by finger and thumb on either side of the tooth. As a rule these teeth have fairly straight roots, and yield readily to slight rotatory movements, especially as the outer alveolar plate is already very thin, allowing frequently the root to be traced along its whole length and over a large portion of its circumference.

In some cases the upper canine, as well as being placed outside the arch, may lie extremely obliquely, or even assume a horizontal position. In these latter cases the removal can be best effected with a curved or straight elevator, previously incising the gum over it, or gouging

away the outer alveolar plate, if this should be of any thickness.

Upper canines may appear inside the arch, but rarely require removal on this account, unless in a useless position, and interfering with the comfort of the tongue.

When assuming this position, upper canines generally have distorted roots, and no rule can be laid down as to the best means of their removal, except that all movements must be made very cautiously, and in what appears to be the line of least resistance, commencing with slight rotatory movements in order to determine this.

The roots of these teeth will sometimes pass between those of the incisors.

Lower canines placed outside the arch may be difficult to remove, but, fortunately, seldom require removal on this account alone. These teeth do not admit of rotatory movements, so that a lateral grasp will not be a favourable one for their removal. Where possible, the blades should be applied to their inner and outer surfaces, the inner blade being fine in order to pass between the adjacent teeth, and the lateral movements must be conveyed almost entirely in an outward direction, so as to avoid impinging against the adjoining teeth.

Lower canines, if much inside the arch, are more troublesome teeth to deal with, partly on account of the difficulty in adapting any of the ordinary forceps to such a tooth, or, when adapted, in preventing loosening of the lower incisor teeth during manipulations.

For these cases curved upper root forceps, or lower straight forceps, are often the best adapted to such a position, and a lateral grasp will be less likely to damage the incisor teeth during their removal.

Occasionally these teeth will present actually in the floor of the mouth, and generally near the middle line.

These cases must be treated on their own merits. In one such case which came under my notice some years ago, lower root forceps, partly and fully curved upper root forceps used in succession, failed to remove the tooth, which was finally removed with the latter forceps a few days later under ether. In this case the tooth also assumed an oblique position, with its crown directed across the middle line.

Premolars are more often misplaced inside than outside the dental arches.

Upper premolars placed outside the arch do not, as a rule, give rise to any special difficulty in their removal, provided there is sufficient room for the inner blade of the forceps between the adjacent teeth. The same holds good when these teeth are placed **inside the arch**, provided in this case there is sufficient room for the outer blade of the forceps. However, when the premolar is placed still further within the arch, allowing the adjoining teeth to come together, the blades of the forceps will have to be applied to the mesial and distal surfaces of the tooth, and the movements made as far as possible in an inward and outward direction; but naturally the latter movement will be much curtailed.

A premolar standing well within the arch may allow sufficient space for the outer blade, and so admit of a lateral grasp.

With regard to **misplaced lower premolars** when presenting outside the arch, as a rule not much difficulty arises in their removal; having conical roots and adapted to rotatory movements, a firm grasp anywhere around their circumference will allow of these movements. When, however, displaced much inside the arch, with their crowns directed inwards towards the tongue, they may be very difficult teeth to remove, and upper curved root forceps or

lower straight forceps will be required, according to the amount of their displacement inwards, the latter forceps being useful with much displacement, and when the crown is directed strongly inwards.

When possible they should be grasped on their lingual and buccal surfaces, but this is not generally applicable to the more markedly displaced teeth.

Whether grasped laterally or antero-posteriorly—*i.e.*, on mesial and distal surfaces—the movements must be first those of rotation and then slight lateral movements, where the adjacent teeth will permit. In those cases where the displacement inwards is slight, lower premolar forceps having an outer narrow blade may be well adapted.

A slight amount of obliquity frequently exists in connexion with lower premolar teeth. This usually takes place in such a way that the buccal surface looks backwards as well as outwards. Beyond causing a little awkwardness in the application of the forceps, no further trouble need be anticipated.

The **molar teeth** most liable to be misplaced are the third molars, and more especially those of the lower jaw. The reason for the more frequent misplacement of these teeth is partly on account of their late eruption after the other teeth have already assumed their position in the dental arches, so that, should insufficient space remain, it is these teeth which must accommodate themselves to some other position, or else remain unerupted. Again, these teeth, being developed deep in the substance of the jaw, are more liable during their growth to meet with some obstruction which diverts them from their normal course. Further, the third molars, being retrograde teeth tending to suppression, are, like all organs in the body in this condition, more liable to faulty development, resulting in abnormalities of shape, position, and structure.

Upper third molars are more often misplaced outside than inside the dental arch, and may assume a position directly external to the second upper molars. As a rule misplaced upper third molars do not give rise to much trouble in their removal; their roots being generally short and agglutinated, and the whole tooth smaller than the anterior molars, they do not offer great resistance to their dislodgment.

Upper third molars are occasionally fused with second molars, or with a supernumerary tooth. Such union is frequently below the gum-level, and not apparent until explored with a probe, and even then very difficult of detection. Fusion may, however, be suspected when the third molar assumes an abnormal position, and in removing the misplaced molar, or the supernumerary tooth, the adjacent teeth must be carefully watched to see that they remain firm during the extractive movements.

Lower third molars may be arrested in their eruption through want of space, or may erupt in abnormal positions, owing to the same cause, and in either case give rise to difficulty in their removal.

Misplacement generally occurs outside the dental arch, although these teeth may be deeply embedded in the ascending or horizontal rami of the mandible, with their crowns appearing internally through the mucous membrane of the mouth, or externally through the skin. In fact, third lower molars are liable to erupt or remain embedded in the neighbourhood of their development, or in any direction radiating from this.

The difficulty in removing misplaced lower third molars lies partly in their inaccessible position, and also in the frequent concomitant swelling of the surrounding parts, which, when infiltrating the masseteric and pterygoid regions, gives rise, in addition, to partial or complete closure of the jaws.

Where, from insufficient space or inaccessibility of position, forceps cannot be used for the removal of such a tooth, a straight elevator is often a most valuable instrument, even when the above unfavourable conditions are absent.

Fortunately, when the tooth has caused sufficient swelling to have produced trismus, the tooth is itself generally slightly loose, and the tissues around soft and yielding from inflammation.

When closure of the jaws is complete, and it is difficult to insert the blade of an elevator between the alveolus and the front of the tooth, such teeth may generally be easily prized up by passing the blade of the elevator down on to the outer or buccal surface of the root, using the margin of the alveolus as a fulcrum, and with a movement of pure supination of the wrist in the case of the left side, or of pronation on the right of the jaw, the tooth will be loosened or dislodged; but care must be taken that it does not pass into the mouth, as under these conditions its further removal would be troublesome or dangerous under an anæsthetic.

By this means a better view of the tooth is obtained, as the blade of the instrument is not in a line with the tooth operated on; frequently it is advantageous to commence the process in this way, and when the tooth is felt to be slightly loosened, the operation may be continued by using the elevator in the ordinary manner.

In either case, when the tooth is once loose, its actual removal from the mouth is completed as much with the finger as with the elevator; in fact, generally by using the two, as the blades of a pair of forceps.

An elevator has been devised for these cases having a short blade, somewhat resembling a single jaw of a pair of root forceps, which passes off at an angle (about 45°) to the shaft of the instrument; while the blade engages the

front of the tooth, the handle assumes a horizontal position to the outer side of the dental arch (Fig. 53). The movements for loosening the tooth are almost entirely rotatory, and where the front wall of the tooth is fairly sound it is a convenient instrument, but being incapable of obtaining a grasp low down on to the root, its use is consequently limited to fairly strong teeth.

When lower third molars are carious or fractured below the alveolar margin, and from their inaccessibility lower root forceps are not applicable, there is not, as far as I am aware, an instrument which satisfactorily meets such cases. A straight elevator does not obtain a sufficiently low grasp on the root even if it reaches the latter; and where closure of the jaws is present, a straight elevator can rarely reach a root much below the level of the alveolus. The modified elevator previously mentioned, with its blade at an angle to the shaft, likewise fails for the same reason.

To overcome these difficulties I constructed an instrument in which the blade is sloped downwards from the shaft, as well as turned obliquely on itself, so that when applied to the front of a lower wisdom tooth, the whole surface of the blade can be brought in contact with its anterior root. The blade is spear-pointed, its anterior surface flat, and its posterior convexly rounded; in fact, the instrument has been so devised that its blade will readily pass down the socket between the anterior wall of the tooth and its alveolus to the depth required. The movements for loosening the tooth are almost solely rotatory, the obliquity of the blade, as well as the shape and size of the handle, assisting in these movements (Fig. 54).

If an anæsthetic be given, the mouth can be gradually opened with a gag, starting, when possible, beforehand, by



FIG. 53.

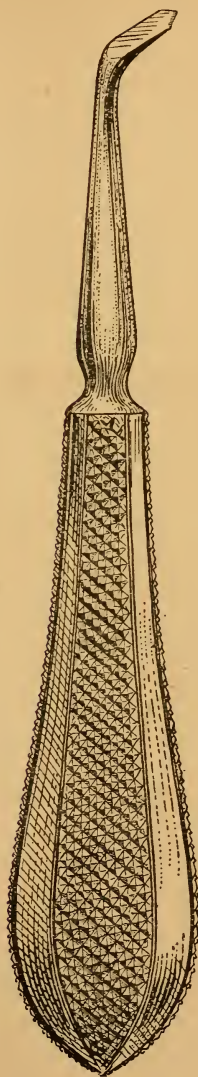


FIG. 54.—(Left Side.)

the insertion of a small prop, so as to economize the time of the anæsthesia.

Frequently the mouth can be opened almost to the full under anæsthesia—although it is inadvisable to do so—and the operation much simplified.

Lower third molars may require removal when they become **impacted**, or from any other reason are prevented from erupting and so causing trouble to the adjacent teeth, bone, and soft tissues.

The most usual cause for impaction is wedging of the tooth between the molar in front and the base of the dense coronoid process posteriorly; the tooth may be so completely shut out that no part of the crown is visible, and the latter even covered with a layer of bone, or one or more cusps, generally the anterior ones, may have erupted, while the rest of the tooth remains embedded in bone.

An impacted lower third molar is best removed with the straight elevator, even if entirely embedded in bone. The blade of the instrument is driven well down in front of the tooth, and by rotatory movements approaches its anterior root. When firmly up against the latter, a continuance of the rotatory movements, accompanied with depression of the elevator, will, in most cases, be sufficient to loosen the tooth. The tooth, when loose, and if space permits, may be lifted out with lower root forceps, as occasionally there is some trouble in delivering it from its bed with an elevator.

When the tooth is deeply embedded in the bone, it will be necessary first to gouge away the weaker wall, so as to expose the greater part of the crown of the tooth, which can be then raised by means of the elevator. This, however, is rarely necessary, as where the tooth is deeply embedded

it generally remains quiescent, and does not necessitate removal.

The extraction of a sound lower second molar, as a preliminary to the removal of an impacted lower third molar, can rarely be necessary or justifiable, although it may undoubtedly simplify the operation.

It is sometimes desirable to remove **unerupted premolars** to remedy a crowded mouth, or where the latter condition is anticipated.

If the temporary predecessors are still present, pass the blades of the forceps well down the alveolus, so as to include both temporary and permanent teeth; the former will be a guide to the crown of the latter, and will also indicate the amount of separation of the blades that is necessary to embrace it.

If the permanent tooth does not follow the removal of its predecessor, the forceps must then be taken and pressed well down into the alveolus, grasping the crown and as much of the root of the tooth as possible.

For these cases, forceps suitable for premolars may generally be used for the removal of the first temporary molar and its successor, and frequently, also, for the second temporary molar and its successor, thus obviating a change of instrument. Tomes, who first suggested the removal of unerupted premolars for certain cases of irregularity of the lateral incisor teeth, recommends that the temporary and permanent teeth in question be removed separately. However, the way I suggest answers exceedingly well, and has the advantages mentioned.

In dealing with misplaced teeth, a good deal of information may be gained by skiagraphy; their position, direction, and relation to other teeth may be made clear, and in other cases their presence or absence determined.

Supernumerary teeth occur most often in the upper incisor region, less frequently in the region of the upper third molars, and require removal when causing irregularity of the other teeth, or if deformed and carious themselves.

They are almost invariably single-rooted, but frequently distorted, and on this account require careful removal.

In the removal of a tooth in a young person, a **neighbouring tooth may be loosened or removed**, if care and precaution are not exercised. In such cases the adjoining tooth will be generally seen to move with the one operated on. When this occurs the operator should firmly press with the left finger or thumb upon the crown of the tooth in danger, and should, in using the forceps or elevator, not apply more force than can be controlled by the finger or thumb, until a severance is felt, when the removal may be safely accomplished.

Should an adjoining tooth be partially or entirely removed from its socket, it should be immediately reinstated, and firmly pressed into its place, when it will most probably again become united to its membranes, and be as serviceable as before.

In removing teeth of young persons with the elevator, especially where an adjoining tooth has not yet erupted, great care must be exercised, or the unerupted tooth may be disinterred also. It is best, therefore, if possible, always to employ the forceps in such cases.

A temporary molar carious to the level of the gum will sometimes take the shape and closely simulate a carious premolar root, and the deception will be increased where the temporary molar is retained beyond its normal time, and permanent teeth are present on either side of it.

With care, any doubt ought to be soon cleared up after

a careful examination of the root with a probe; looseness without any apparent sign of inflammation would point strongly to a temporary root.

The resemblance is more pronounced in the lower jaw, and is occasionally sufficient for the exercise of great care in its removal. The blades of the forceps should be passed only sufficiently deep to remove what is assumed to be a temporary root. The sensation of less resistance of a temporary root will be at once apparent; at the same time, insufficient force is used to cause a fracture, should the root be that of a permanent tooth.

Teeth, as previously stated, are sometimes found united to each other at their roots (**gemination**); the resistance to removal which such will offer can be well imagined.

It is almost impossible to diagnose such a condition or the existence of extensive exostosis beforehand; and as there is frequently no reason to suspect such a condition being present, skiagraphy is not brought into use.

Whilst exercising every care, it is at times impossible to avoid removing with the tooth small portions of the alveolus.

Thus, especially with the upper first molars, the outer alveolar wall is often thin and slight, and these thin portions yield more readily than does the periodontal membrane. In some cases such an accident is quite unavoidable, as portions of the alveolar plate are firmly adherent to the root of the tooth, and even after its removal can only be broken away with difficulty.

With the other teeth it is less usual for portions of the alveolus to remain attached to the root, and where the bone around is dense, or the tooth necessitates rotatory movements for its detachment, this accident rarely occurs.

The removal of a small portion of alveolus, either with

a tooth or directly following its removal, is not of any grave consequence. It may slightly delay the granulating up of a socket, but otherwise, as it would subsequently become absorbed, is not of any great importance, provided it does not involve part of an adjoining socket. In the latter case looseness or necrosis of the teeth involved would result, and possibly the discharge of sequestra.

Occasionally after the extraction of a tooth, and more especially when several contiguous teeth have been removed, the alveolus is left prominent, and can be felt with the tongue, giving rise to the impression that part of a tooth has been left in. This condition is best treated by oral cleanliness, and in a few days any sharp edges will be rounded off and covered in with granulation tissue. It has been recommended to pare off the prominent portions with bone forceps; but this is rarely necessary, and may open up fresh bone to infection, especially as this condition tends rather to occur in those cases where there has previously been some suppurative condition causing **stripping of the mucous membrane from the alveolus**.

Should larger portions of the alveolus be fractured, their removal or retention will depend partly on their size, position, and attachment to soft structures. If involving the stability of adjoining teeth, our efforts should be directed to their retention. Further, if they form part of the wall of one of the natural air cavities—*e.g.*, the antrum—their retention should be preserved, if possible, until such cavity is shut off from the mouth. Where, again, a large portion of the alveolus is fractured, but held in position by the surrounding soft structures, and by its presence not interfering seriously with mastication, this, again, should be preserved, and in the maxilla will almost certainly unite with the rest of the bone.

Cases of direct transverse **fracture of the lower jaw** have

occurred—the result of attempting to remove a tooth—and under the hands of those whose skilfulness as operators has never been questioned.

It can be understood how this most unfortunate complication might occur when only a very moderate amount of force has been employed, in cases where the jaw is the seat of some pathological condition—*e.g.*, atrophy arising either from disease or as a senile change, mollities ossium, etc.

More limited fractures, involving chiefly the alveolar plate, are of more frequent occurrence, and are recorded from time to time. They occur generally in the maxilla, and the outer alveolar plate is that usually involved.

Portions of the outer alveolus corresponding to one or more teeth have at times broken away during the extraction of an upper tooth, and Salter records a case where both the outer and inner plates of the alveolus were fractured during the removal of upper central incisors, the fracture passing through the entire thickness of the upper jaw, and limited laterally by vertical fractures in the region of the canines, and above and below by horizontal fractures joining these respectively at the level of the root of the nose, and about the same distance behind the incisor teeth, so that a portion of bone roughly corresponding to the two intermaxillary bones was isolated, and only held in position by the soft tissues. Fortunately, this fracture united without any serious consequences.

Horizontal fractures of the outer, inner, or both alveolar plates of the mandible have at times occurred during the removal of a tooth, more especially in connexion with a first permanent molar. The fracture is generally limited below to the apices of the teeth, but may involve one or more alveoli, as in one case recorded, where, in extracting a lower right molar the fracture involved also the alveoli of the

premolars and canine, which were entirely separated by a horizontal fracture from the body of the bone.

Fracture of the tuberosity of the maxilla may occur during the removal of the third upper molar, and has sometimes followed that of the second molar. This fracture is more liable to occur when the tuberosity is prominent, and has a constricted neck—in fact, is pedunculated. In these cases the fracture is generally limited to the tuberosity, and so is not of such grave importance as where portions of the antrum, sphenoid, and palate bones are also brought away.

Such a case is recorded by Cattlin, and the ultimate result was deafness on the injured side. The hamular process and the tendon of the tensor palati muscle were involved, leading to collapse of the opening of the Eustachian tube, and permanent restriction of the movements of the jaw by the involvement of the pterygoid muscles and ligaments around the temporo-mandibular articulation.

Recently I witnessed a fracture of the left maxillary tuberosity, following the extraction of a third upper molar. Here the fracture was limited to the tuberosity, bringing away with it a small portion of smooth bone on its inner aspect, corresponding to part of the floor of the antrum. The opening into the antrum would probably have barely admitted a goose-quill. Such an opening would be temporarily closed with blood-clot and inflammatory swelling of the soft tissues around.

The patient was advised to keep his mouth as clean as possible, and to be seen on the following day. An examination of the opening with a probe would be of no benefit, and the packing of the same would tend to keep the opening patent and more liable to infection. In a few days the antrum was shut off, and no further trouble arose.

I had the misfortune a few years ago to fracture the right maxillary tuberosity in attempting to extract the roots of a second molar previously fractured at the level of the gum.

The patient, a man, gave the history that two attempts at the removal of this tooth had been made elsewhere.

During the extraction of these roots the tuberosity was felt to move and to be loose, being only held in position by the soft tissues around. Two of the roots were extracted fairly easily, but the third left owing to the condition of the tuberosity.

No undue force was used, but upper root forceps were pressed well up into the alveolus on account of the history of previous failures at extraction.

The condition present after the removal of the two roots was the following: The right maxillary tuberosity, containing a sound third molar, was loose, but the mucous membrane intact all round, except in the region of the palatine root of the second molar, where there was a tear of about $\frac{1}{4}$ inch, exposing the bone.

Whether in previous attempts at extraction of the tooth some injury was done to the tuberosity I am unable to say, but must admit there was no apparent injury at the time I saw the patient. I thought it desirable to leave the tuberosity *in situ* for a day or two, as immediate removal would probably have opened up the antrum. The tuberosity was firmly attached by the soft tissues, and retained in fairly good position, except that through its bony disconnexion it had slightly dropped, preventing the patient from closing his mouth and causing pain in attempts to do so.

Whether in this case the tuberosity eventually united to the maxilla or remained loose and had to be subsequently removed can only be surmised, as, unfortunately, the patient

did not return, although told to do so on the following day.

Other cases where fracture of the maxillary tuberosity has followed removal of a second molar have been reported.

Another accident attendant upon extraction of teeth is **dislocation of the mandible**, and in these cases is almost invariably bilateral. It most frequently occurs while a patient is under anæsthesia, doubtless in consequence of the relaxed condition of the muscles, but possibly also assisted by other conditions present—*e.g.*, the mouth is often kept widely open by a prop in the molar region, and consequently the condyle of the jaw is already partly resting on the eminentia articularis. In this position it would require but little force when the condyle is depressed, as in extracting a lower back molar to displace it still further on to this eminence, when sudden contraction of the external pterygoids, or any forward movement conveyed to the jaw by the operator, would be sufficient to complete the dislocation.

Such dislocation may not be apparent as long as the prop remains in the mouth, and frequently it is not until the patient returns to consciousness and the prop is removed that inability to close the mouth is noticed.

In the same way, when the mouth is opened widely by a gag on one side, and during the extraction of a back tooth on the opposite side, the conditions may again be present, favourable for a dislocation, provided the tooth to be removed is posterior to the fulcrum, in this case formed by the gag.

During the removal of such a tooth under the above conditions the jaw is still further depressed, and so the condyle tends to mount still further on to the eminentia articularis, until by a final depression of the jaw, with

stretching of the capsule, the condyle clears the eminence, and is rapidly drawn over by muscular action, assisted by any forward movement conveyed to the jaw as may be exerted whilst the alveolus is embraced by the fingers, or even by the weight of the arm in front of the fulcrum.

Apart from anæsthesia, dislocation may also occur when a lower tooth, generally a posterior one, is being removed, and occasionally occurs under quite trivial circumstances—*e.g.*, on protruding the tongue, widely opening the mouth, yawning, etc. But under these conditions there is generally some pathological condition of the temporo-mandibular joint present—*e.g.*, laxity of the capsule (subluxation).

The condition is easily diagnosed; the patient becomes greatly alarmed if it be the first time dislocation has occurred, and will ejaculate and point to his mouth, which remains partly open, the lower jaw projecting downwards and remaining fixed. If the patient is not seen immediately, saliva will be noticed dribbling over the lower lip. The condyle can be detected in a false position, and a hollow can be both seen and felt in its normal position in front of the tragus. The angle of the jaw passes backwards from the condyle, due to the obliquity of the ascending ramus. The coronoid process will be detected below the anterior part of the zygoma, on examination with a finger in the mouth and on the outside.

As the capsule is not torn in this form of dislocation, the jaw is generally easily reduced by depressing the condyle below the level of the eminentia articularis, the attachment of the temporal muscle to the coronoid process acting as a fulcrum until the condyle is disengaged from the eminence, when the internal pterygoid, masseter, and posterior fibres of the temporal muscles will at once draw it into its proper position.

The above is best carried out by standing in front of the patient, who should be seated. The thumbs are well wrapped round with thick napkins, or the corner of a towel, to a point beyond that enclosed by the lips, and pressure exerted with the thumbs in a downward and slightly backward direction, as far back in the molar region as possible ; at the same time the fingers should be spread out under the chin, and exert pressure in an upward direction as soon as the condyle is felt to be disengaged. As a rule, however, as soon as this stage has arrived, the jaw is violently retracted into its position by its muscular attachments ; and it is in this part of the process that the thumbs are liable to be crushed if not protected.

Other methods have been suggested—*e.g.*, by placing corks or wooden blocks between the molar teeth and forcibly elevating the chin. In this case, the fulcrum being formed by the wedge used, this method is not to be recommended. The attached temporal muscle forms a better fulcrum, it is not absolutely rigid, and is thus capable of conveying to the fingers the amount of force that is being applied, and how much it is desirable to use.

In cases of unilateral dislocation, the lower jaw is directed towards the side opposite to that on which the displacement exists, and there is a hollow present in front of the tragus on the injured side, which becomes noticeable on comparing the two sides. The jaw is not so widely opened, and allows of a little movement by means of which the position of the dislocated condyle can be detected. Most of the other signs are present as before, their modification depending upon the unilateral condition present.

The reduction of a unilateral dislocation is carried out on precisely similar lines as when complete, except that

the force exerted by the thumbs is applied to the injured side only.

The further treatment of such cases consists in giving support to the jaw and preventing its full range of movement. This may be temporarily accomplished by a four-tailed bandage; but as soon as possible this should be supplanted by a skull-cap, attached on either side by a broad, and not too elastic, band to a small chin-cap.

The apparatus should be worn day and night for several weeks, and may have to be worn permanently where there is a laxity in the capsule of the joint, as in the condition termed subluxation. In these latter cases constitutional treatment is of as much, if not more, importance.

No doubt, after the continual wearing of a support for a long period, the movements of the jaw will tend to become permanently restricted by the shortening of the capsule, ligaments, and muscles around the joint, and the apparatus may then be discontinued.

A certain amount of periostitis and osteitis normally follows the extraction of teeth, or granulation tissue would not be formed with the subsequent changes which lead to the repair of the socket.

Under favourable conditions this inflammation is temporary, lasting for two or three days, and only causing discomfort for a few hours. As teeth are generally removed for pathological conditions—either in themselves or in their surroundings—some degree of osteitis is frequently already present, and may have extended some distance from the primary focus. It is well to remember this, as the removal of a tooth in such cases may not give immediate relief, and the condition may pass on to suppuration; if the patient is not warned of this beforehand, any subsequent pain or swelling will be put down to carelessness or neglect on the part of the operator.

Where an abscess is present, and the tooth is merely acting as a cork in preventing its escape, extraction will be followed by some immediate relief from the removal of tension.

It is a wise precaution, when there is any inflammatory swelling around the tooth, to inform the patient that there will be some discomfort for a day or two following its removal, and, if possible, to see the patient on the following day.

It has been mentioned above that local conditions—*e.g.*, periostitis, osteitis, alveolar abscess, etc.—existing at the time will be attended with **pain following upon extraction**, and cause delay in the granulating up of a socket; likewise, constitutional conditions—*e.g.*, debility, recovery from one of the exanthemata, etc.—may lead to infection of a wound which in a healthy person would heal quickly and soundly.

The causes of **osteitis** following upon extraction of teeth, apart from what must unavoidably occur through trauma, may be classified into *direct* and *indirect*, or immediate and remote. Of the former, trauma is the most important.

The amount of trauma inflicted in the removal of a tooth is least when the root is conical, and in these cases nothing more than a slight dilation of the alveolus around the neck of the tooth occurs. In similar cases, but with slight tortuosity or bend of the root, the socket will be dilated or distorted over part of its length.

In teeth with multiple or irregular roots, or where lateral movements are necessary for loosening a tooth, a variable amount of bending of the alveolus occurs, which, if beyond its limits of elasticity, will result in fracture, in either case leading to subsequent periostitis and osteitis, and consequently pain.

The outer alveolus of an upper or lower canine is liable to be bent or displaced outwards during the extraction of these teeth, and similarly the outer alveolus of a first upper or lower molar ; in both cases giving rise to discomfort and delay in the healing of the socket.

After the removal of any tooth, it is desirable to apply gentle but firm pressure on either side of the alveolus. This will tend to reduce the alveolus to its natural size, and restore any distortion, should such have occurred.

A local osteitis, lasting a few days to a week or more, may follow injury to the alveolus in removing a portion of a tooth deeply embedded in the jaw, or after any difficult extraction, and is prolonged in the case of the mandible owing to the dense bone around and less favourable position for drainage. Small portions of fractured alveolus may be exfoliated from the socket, or flakes of necrosed bone come away in the discharges.

The soft tissues around the alveolus become inflamed and separated from the latter, exposing bare bone ; the contour of the socket will be found distorted, or to bulge in one or more places.

Pain is frequently intense for the first few days, but gradually diminishes if oral cleanliness is strictly carried out. Carbolic acid and potash* forms a useful mouthwash for serving this purpose, the latter dissolving any adherent mucus, epithelium, or necrosed tissue, and allowing the former to pursue its antiseptic and anæsthetic properties.

Besides oral cleanliness, treatment will consist in removing loose fragments of bone, moulding the alveolus into its natural shape when recently injured, and swabbing

* R	Liquoris potassæ ..	..	..	..	f ʒi.
	Acidi carbolic liquefacti ..	..	..	..	f ʒss.
	Tincturæ cocci ..	..	..	..	q.s.
	Aquam ..	..	..	..	ad f ʒi.

Misce.

Use one teaspoonful in half a tumbler of warm water.

out the socket with pure carbolic acid. This is best applied on a small piece of cotton-wool of a size that will readily pass down each separate root-socket, removing any excess before its introduction.

A portion of bare alveolus will often closely resemble a fractured tooth, and the patient's subjective symptoms will not aid in the diagnosis. However, the latter condition can be excluded if a probe passes freely down each socket, as well as by the other points already mentioned.

The above method of treatment modified will be found useful in relieving pain where portions of a live root have been left in the alveolus. In this case the action of the carbolic acid should be restricted to the exposed portion of nerve, its action being that of a caustic. A superficial slough is formed, destroying conduction of sensation, and its anæsthetic properties may likewise help in the same, or a strong solution of silver nitrate may be used in a similar way.

Some leave a dressing of carbolic acid in the socket, and allow this to work out by itself. Probably no harm will arise from this, provided no excess of carbolic acid is used. Another method of prolonging the action of this drug is by combining it with glycerine; this makes a tenacious mixture, which is less easily washed away in the mouth.

Besides this local application, an anodyne mouth-wash should be prescribed; and one of the most comforting for this purpose is obtained in reducing by boiling 2 ounces of poppy-heads in 1 pint of water to $\frac{1}{2}$ pint, and adding 10 grains of potassium chlorate to every ounce of poppy fomentation; or 10 minims of tincture of opium may be added to an ounce of a watery solution containing 10 grains of potassium chlorate.

This should be used as hot as can be comfortably borne

by the mouth ; and no doubt the warmth is as effective in relieving the pain as the contained drug.

The same may be used in these cases as a large fomentation applied externally, with but little danger of inducing the inflammation to spread from its local site.

Extensive laceration of the soft tissues apart from, or in addition to, bending or fracture of the alveolus will increase the amount of osteitis already present, and the latter will be more liable to pass on to suppuration, ending, perhaps, in necrosis of the alveolus.

Besides injury to the alveolus and soft tissues around, the terminations of the fifth nerve entering the apical foramina are necessarily torn during the removal of a tooth. This separation is followed by a local neuritis, which may extend to the trunk of the nerve when in close proximity—*e.g.*, in the posterior lower molars—or affect the trunk subsequently if the wound becomes infected.

Fortunately the fine nerve terminations generally rupture at their entrance to the apical foramina, and the neuritis is limited to this region.

Small portions of nerves will sometimes remain attached to the roots of the teeth. This occurs more especially in connexion with upper molars which are fairly sound. These attached nerves are rarely more than $\frac{1}{8}$ inch in length, and are frequently found on each root of the tooth.

No subsequent trouble follows their removal.

Why in some cases small portions of nerves remain attached to the ends of the roots while in other teeth the nerve breaks at the apical foramen is difficult to explain, and certainly does not depend upon any constriction at this point, or else we should expect to find portions of nerves attached to teeth which have large apical foramina, whereas in connexion with these teeth the condition is rarely seen.

Moreover, as stated above, the condition generally appears in connexion with sound teeth or those presenting but little caries.

The reason why portions of the maxillary nerves more frequently remain attached to the anterior upper molars may be an anatomical one, depending upon these teeth being supplied by small short branches, given off at right angles from the convexity of the arch formed by inosculatation of the anterior and posterior dental nerves.

In some cases the lower third molar has a very direct relation with the trunk of the **inferior dental nerve**, and grooves may be detected near the termination of its roots, along which the trunk of this nerve lay.

Sewill records a case where one root was perforated and the other grooved by this nerve, the extraction in this case being followed by temporary loss of sensation over the region supplied.

The sensory area supplied by the inferior dental nerve roughly corresponds to the chin, both surfaces of the lower lip from the middle line to the region of the first premolar, and the gums around the lower teeth, by filaments from the branches, going to the same.

Any loss of sensation (epicritic and protopathic sensibility of Head and Sherren) in the above area from injury of the inferior dental nerve is generally soon recovered from, and this area is somewhat diminished by the overlapping of the sensory fibres contained in the fifth and seventh nerves, more especially the lingual, long buccal, and supra-mandibular nerves; deep sensibility is unaffected.

The **lingual nerve**, from its position, is also liable to injury during the extraction of a lower third molar, as it passes from under cover of the anterior border of the internal pterygoid on its way from the side of the jaw to that of the tongue. In this position the nerve lies about

$\frac{3}{4}$ inch behind and below the last molar tooth, and is only covered by mucous membrane.

Injury to the lingual nerve will result in a loss of sensation over the anterior two-thirds of the same side of the tongue, adjacent floor of the mouth and inner side of the jaw. There is also paralysis of the submaxillary and sublingual salivary glands, with diminished secretion and loss or impairment of the sense of taste over the same part of the tongue.

The remote causes of periostitis and osteitis resulting from the removal of a tooth are chiefly those referable to sepsis.

Pyogenic organisms may be introduced at the time of extraction through want of using clean instruments, hands, etc., or subsequently through want of oral cleanliness, the former being entirely the fault of the operator, unless the mouth previous to the operation was in an unhealthy condition.

The osteitis following will be severe, according to the condition of the mouth, the variety of organism introduced, the position of the wound, and the precautions taken in treating such a case.

Foreign bodies gaining access to a socket or irritating the same will prolong and increase the osteitis—*e.g.*, tartar, a dirty pipe, etc.

After the removal of a tooth, besides prescribing a mouth-wash, the patient should be limited to a soft, or, better, a fluid diet for that day and possibly for the following.

In some mouths, where the teeth, gums, and cheeks are in an unhealthy condition—*e.g.*, ulcerative stomatitis in children—it is desirable to delay extraction until the mouth is brought into a more healthy condition, as in these cases any wound in the mouth will be immediately

infected from its surroundings, take on an unhealthy aspect, and even become a serious danger.

No doubt the removal of carious teeth with suppuration and sinuses around is desirable in helping to get the mouth into a more healthy condition; still, there are cases where to inflict any fresh wound under the present conditions is most undesirable, and, personally, I have seen on more than one occasion a **localized gangrenous stomatitis** commence from such a wound, involve the sockets of two or three of the adjacent teeth, and lead to necrosis and gangrene of the soft parts.

Severe cases of ulcerative stomatitis are frequently seen in young children improperly clothed and fed, living in poor, crowded and unhygienic surroundings.

Some of the more severe cases of ulcerative stomatitis closely resemble cancrum oris, and the two conditions are probably only different degrees in the same disease, whether the gangrene remains localized or spreads, as in cancrum oris, depending upon the acuteness of the inflammation and the debility of the child.

When the condition is not so serious, the child's mouth may be brought into a more healthy condition by cleansing the teeth and gums with absorbent cotton-wool soaked in a lotion containing potassium chlorate (20 grains to 1 ounce), and in older children the same, slightly diluted, may be also used freely as a mouth-wash.

In addition, potassium chlorate is administered internally up to 20 grains in the twenty-four hours.

Later, when the gums and mucous membranes are less tender, a very soft brush may be substituted for the wool. The bowels in these cases are almost invariably confined, and castor oil forms one of the best purgatives, and in some cases is well combined with a little brandy.

In this way, in a few days, the mouth may be brought

into a much cleaner condition, and any tooth causing swelling, pain, or aggravating the stomatitis already present should be removed; but as a rule this condition, when extensive, does not primarily depend upon a local cause, and any swelling around a tooth must be looked upon as of secondary importance, the constitutional condition being a far more important factor.

Frequently I have found the teeth, after removal of the debris in which they were embedded, to be sound and free from caries, although well-marked ulceration of the gum and cheek was present in their neighbourhood.

In cases where suppuration exists at the time of the extraction, the removal of the diseased tooth will generally lead to a quick subsidence of the swelling when confined to the region of the tooth. Further treatment will consist in oral cleanliness, syringeing the socket with some warm non-irritating antiseptic—*e.g.*, boracic lotion—after meals, and removing any loose or necrosed fragments of bone. A saline purgative* should be prescribed, and, if necessary, a tonic.† For these purposes the undermentioned are useful formulæ.

When suppuration from a tooth-socket has continued for some weeks or months, portions of the jaw containing one or more alveoli may **necrose** and eventually become exfoliated.

A short time ago I removed a loose piece of necrosed

* R	Magnesii sulphatis	..	..	..	℥i.
	Acidi sulphurici dil.	..	..	..	℥x.
	Syrupi papaveris rubri	..	..	..	℥ss.
	Aquam menthæ piperitæ	..	..	..	ad f ℥i.
	Misce.				

† R	Liquoris strychninæ hydrochloridi	..	..	..	℥iii.
	Acidi phosphorici dil.	..	..	..	℥xv.
	Spiriti chloroformi	..	..	..	℥xv.
	Infusi quassiae	..	..	..	ad f ℥i.
	Misce.				

bone extending from the left wisdom tooth to the right incisor region. The sequestrum involved the entire sockets of the molar teeth, the inner alveolus of the remaining teeth, and portions of the body of the mandible.

There was no history of syphilis. The patient dated his trouble from the removal of a lower left molar two years previously. In this connexion it may be remarked that a history of two years' duration is not unusual for cases of necrosis of the mandible, in which situation sequestra are very slow in separating.

Suppuration from a lower tooth, generally a molar, will sometimes track some distance down the neck under the deep cervical fascia (Ludwig's angina) even as far as the

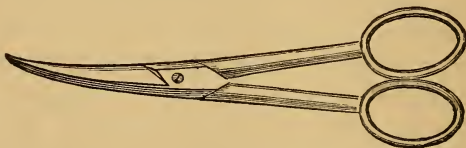


FIG. 55.

clavicle, and in a few recorded cases into the mediastina, terminating fatally.

These cases will require, besides removal of the tooth, a counter-opening in the neck below the jaw at the most dependent part of the swelling. These are serious cases requiring immediate attention; and must be referred to a surgeon. Generally the two operations are better done at the same time, when the patient is in the wards of a hospital or at his own home.

Suppuration arising from a lower tooth in front of the molar region is more liable to track in the sublingual region, giving rise to a fulness below the chin and pushing up the floor of the mouth.

Other complications which occur during tooth-extraction

include some which are avoidable—*e.g.*, injuries to the gums, tongue, and lips—and others which are unavoidable, or to some extent so—*e.g.*, the forcing of a root into a pre-existing cavity, as the antrum, or into an abscess, cyst, or space formed through separation of the soft tissues from the alveolus.

Hæmorrhage will also come into this latter category.

Laceration of the gum has been mentioned previously. In most cases when separated from the alveolus the gum will regain its attachment, if the mouth be kept clean.

Any pendulous portions may be snipped off, and the remainder, if necessary, stitched with one or more silk sutures to the opposite lip of the socket; but as a rule the gum tends to lie in this portion without further aid.

In the removal of a third lower molar, and less frequently with other teeth, the gum will occasionally remain adherent to their neck posteriorly after the tooth itself is loosened or actually lying in the mouth.

If the gum only remains slightly adherent, the tooth can easily be separated by a slight twist, at the same time pressing on the attached soft tissues to prevent their stripping up. Where more firmly adherent, such a tooth is better left until its attachment can be divided with curved scissors or lancet (Figs. 55 and 56).

The gum is more liable to remain adherent to these teeth when their removal is carried out with an elevator, the attached gum forming the radius around which the tooth travels when raised from



FIG. 56.

its socket. In these movements the gum in this situation is not put to any great strain, and remains intact.

The factors contributing to this condition are the isolation of the third molar posteriorly and the loose attachment of the soft tissues behind the alveolar arch in this region, as previously mentioned in connexion with the dislodgment of teeth into this recess.

Hæmorrhage from laceration of the gum is rarely serious, although it may be profuse for a short time, and is generally soon controlled by the use of cold, either more generally in the form of a mouth-wash, or locally as an ice-pack, made by filling small calico bags with pieces of broken-up ice. The bag is laid across the alveolus, and held there with a finger by the patient, replacing the bag with fresh ones if necessary, and from time to time removed from the mouth to allow swallowing. A mouth-wash cannot be used with comfort sufficiently hot to allow of any benefit being derived by this means. If heat is to be used as a hæmostatic, it is best applied in the form of the cautery, of which a small Paquelin's is the most convenient.

If the use of cold lotions fail to stop the hæmorrhage, tannic acid dissolved in glycerine (1 in 5) may be applied over any raw surface of gum, or soaked in cotton-wool, and packed directly against the bleeding surface, or used as a mouth-wash (glycerinum acidi tannici) 1 in 8.

Adrenalin (0·1 per cent.) is likewise useful in these cases, combined with plugging.

If these means fail, stitching up a socket will in most cases stop any hæmorrhage almost immediately, and at the same time cover any bare alveolus.

The patient should avoid spitting out blood as much as possible. This tends to encourage hæmorrhage by its suction action prior to the act of emission, and in the same way the too frequent use of a mouth-wash is undesirable.

It must be remembered that hæmorrhage from the mouth is always more apparent than real. A drop or two of blood in the mouth will be sufficient to tinge an ounce or more of saliva to such an extent that it will appear almost like pure blood ; and any meddlesome treatment in such slight cases is to be deprecated.

Injury to the floor of the mouth may occur in removing a lower back tooth if the inner blade be opened too wide, or where a tooth or root inclines inwards towards the floor of the mouth. The mucous membrane in this region is loose and in folds, and during anæsthesia becomes swollen and turgid, filling up the space between the tongue and teeth, and pushed over towards the latter by the swollen tongue.

Wounds of the tongue must in most cases be due to carelessness—the slipping of an elevator or forceps would account for such an accident. Here again hæmorrhage may be at first profuse, but will as rapidly diminish, unless a large branch of the lingual artery is involved.

As the wound is generally a small puncture, a single suture will bring the edges well together, should such be necessary.

If blood spurts out freely through the puncture, indicating that an artery of some size is involved, the finger should be passed well to the back of the mouth, and the base of the tongue hooked forward against the hyoid bone. This compresses the lingual artery against the latter, and an attempt should then be made to seize the vessel with pressure forceps, temporarily relaxing its compression to see clearly from where the hæmorrhage is arising ; but failing this, means must be obtained for possible ligature of that artery.

In addition to wounds of the tongue and floor of the mouth through the slipping of an instrument, **the lips may also be injured** in the same way, or actually perfo-

rated, as has occurred during the extraction of an upper front tooth. The blades of the forceps slipped and perforated the upper lip; however, in a few days the latter was soundly healed.

In this position hæmorrhage can be easily controlled by compressing the lip between the two fingers, or by pressure over the maxilla, when the bleeding-point is above the sulcus of the lip. In most cases the hæmorrhage will cease spontaneously, and will rarely require the ligature of any vessel.

The lower lip is liable to be bruised against the lower teeth during the extraction of upper teeth. This should be avoided by using forceps with handles at such an angle to the blades as to be clear of the lower lip during the extractive movements. This accident occurs more often during anæsthesia, and while the inward movements are being conveyed to an upper molar, especially when the mouth is insufficiently opened by a prop or gag.

The operator may be unaware of any untoward result until the lip begins to swell on the following day, or earlier. The application of a simple ointment containing oxide of zinc, or boric acid, is all that is generally required. The skin is not, as a rule, broken, and in a day or two all subsides.

The swelling from such a bruise will sometimes rapidly appear, and in less than an hour the whole lip may be involved in a bluish, tense swelling consisting chiefly of blood.

A root in the upper premolar or molar region may be forced into the antrum during attempts at its removal, and from the anatomy of this part, and its condition when inflammation is present, such an accident would be expected to occur more frequently than it apparently does.

The conditions which might induce such an accident

would be attempts at removing either a premolar root or the buccal roots of a first or second molar, especially if ill-defined, in which case one or both blades of the instrument may be directly pressing on to the surface of the root, and project the latter partly, or entirely, into the antrum. Again, the root may be only just within the grasp of the blades, and in closing the latter, the root is shot out of their grasp deeper into the tissues, or even straight into the antrum.

In a similar way a root may be **forced into an abscess, cavity, or cyst**; but a commoner condition is for a root to become dislodged and **forced into a space caused by the separation of the gum from the alveolus**, especially where the gum is but loosely attached, as on the inner side of a lower third molar.

This accident is liable to occur in using an elevator for the removal of a lower third molar. The tooth may be raised from its socket and travel upwards and backwards, stripping the loose mucous membrane from off the jaw in the region of the internal pterygoid muscle, giving rise to the impression that the tooth has left its socket and fallen into the mouth. Again, in removing the second root of a lower molar with a curved elevator, if the socket has been previously damaged, the root may be forced between the gum and its alveolus.

Where there is much oozing of blood and the tissues have been previously damaged, it may be very difficult to localize such a root, and it is advisable to wait until bleeding has ceased and inflammation partly subsided, when the root may be clearly seen between the gum and alveolus, or found forced into some other unnatural position, and easily removed.

When a tooth or root has been forced into the antrum, the treatment to pursue will depend upon whether the tooth or root was previously healthy and the condition of the antrum.

Where an apparently healthy root has been presumably forced partly into the antrum, such a root is better left in this position, unless subsequently, by giving rise to inflammation, an empyema of the antrum results, in which case an attempt must be made to remove the root by using very fine forceps, and keeping the blades apart until well down on the root, when they should be gently but firmly closed; and if a fair grasp of the root is obtained, the latter is easily removed.

No doubt the subsequent inflammation which has occurred will have loosened and slightly extruded the root, and have made it easier to obtain a firm grasp, but a very little force in the opposite direction will be sufficient to dislodge the root entirely into the antrum.

There are no pathogenic signs of the partial dislodgment of a root into the antrum, and the condition can only be surmised when a root in that region appears to sink further into the tissues on attempts at extraction. Subsequent signs of infection of the antrum would make it appear probable that such an accident has occurred, and if a silver probe passes into the antrum after the successful removal of the root, the condition will be verified. Whether partial or complete dislodgment of a root into the antrum is suspected, a skiagraph should be obtained, and if it shows a tooth or root lying free in the antral cavity, the further treatment again will depend upon the previous condition of the tooth. A healthy tooth or root will become encysted, and probably never give rise to any further trouble, and treatment will consist in keeping the socket clean. The perforation will be almost immediately closed, and in a few weeks permanently shut off by the deposit of bone.

When the antrum has previously been diseased, or a contained tooth or root subsequently causes inflammation or suppuration, it is desirable to get rid of the foreign body,

and the method employed will depend on its localization by skiagraphy.

In those cases where the foreign body still lies in the region of the perforation, it may be possible to remove it by means of wire, bent up at the end into a hook or cup, the ends of which may be covered with some sticky preparation—*e.g.*, gum tragacanth.

If the above method fails, or where the foreign body is localized and found to be some distance from the perforation, the latter must be enlarged, and an attempt made to dislodge the foreign body by syringeing large quantities of warm saline or boracic lotion into the antrum, in the hope that the return current will bring it away. Should this fail, a further attempt may be made by the wire loops, a small curved spoon, or any other instrument suggesting itself; but again failing, the perforation must be enlarged sufficiently to admit the finger; its removal is then readily effected. The antrum should be washed out, and the subsequent treatment will be similar to that for acute suppuration of the antrum.

The causes of a tooth or root becoming dislodged into an abscess cavity or cyst will be similar to the above, and the same will be easily removed, either with tooth forceps, dressing forceps, elevator, or some form of scoop.

The treatment for such a condition necessitates in itself making a free opening, and through this a powerful syringe will in most cases wash away any loose foreign body.

The subsequent treatment will be that for the condition present.

Most of the above conditions are more liable to occur when removing teeth under anæsthesia, and, in addition, there are certain accidents which occur almost solely under anæsthetics. These will be mentioned in connexion with that chapter.

Hæmorrhage following Tooth Extraction.

Briefly, the arterial supply of the upper and lower jaws and their surrounding parts is derived from the **external carotid artery**. The teeth of the maxilla are supplied by the anterior and posterior dental arteries, while those of the mandible receive their arterial supply from the inferior dental artery—branches of the internal maxillary.)

The surrounding soft tissues on the outer side of the jaws are supplied chiefly from branches of the facial artery, and on the inner side by branches of the internal maxillary or deep facial and lingual arteries.

Hæmorrhage following tooth extraction is derived from two sources: the alveolus, or bone surrounding the teeth, and the mucous membrane, or soft tissues in relation to the latter; the larger quantity being derived from the former source.

Normally such hæmorrhage ceases within half an hour, and in less than five minutes after the extraction of a tooth there is nothing more than a very slight oozing from the wound.

About $\frac{1}{2}$ ounce may be looked upon as an average amount of pure blood lost after the extraction of a tooth; but this may vary up to 2 or 3 ounces or more without being excessive, and will be several times this amount before giving rise to any unpleasant symptoms.

Hæmorrhage is generally more profuse when extraction follows previous inflammatory conditions of the mucous membrane and surrounding parts—*e.g.*, *periostitis*, *alveolar osteitis*; or where there is some pathological condition present, causing engorgement of the vessels in the neighbourhood—*e.g.*, *polypi*, *granulomata*, *ulcers*, *new growths*, *nevi*, etc.

One of the most severe cases of bleeding following extraction that I have seen occurred in an old and feeble man. Most of his teeth were loose through alveolar osteitis; pus was oozing freely from the gums around the teeth, and the latter were encrusted with tartar. His tongue showed chronic superficial glossitis, with patches of acute inflammation; in fact, his mouth was in a very bad condition.

Several teeth from both the upper and lower jaws were removed with the idea of relieving his chronic superficial glossitis, and the effect on this was both rapid and marked; but the patient was in the ward of a hospital for nearly a week before he recovered sufficient strength to get about.

Bleeding followed removal of the teeth and continued throughout the day. The ordinary remedies had little or no effect in reducing the hæmorrhage, and it was not until the sockets were sutured that bleeding diminished and finally ceased.

When seen two or three weeks later, his glossitis had all but disappeared, and the patient, although still weak, expressed himself as feeling much better.

On other occasions I have noticed very free bleeding follow the removal of loose teeth associated with alveolar osteitis, and in such cases in old people it is advisable to limit the extraction to a few teeth, even where several loose teeth may require subsequent removal.

Other conditions in which hæmorrhage after tooth extraction may be excessive, or even fatal, depend upon constitutional conditions, and some of these are included under the term of "blood diseases," comprising *scurvy*, *purpura*, and *hæmophilia*.

Hæmorrhage is also said to be more profuse if tooth extraction be undertaken during a *menstrual period*, and

such hæmorrhage may partially or entirely replace a normal menstruation, in the same way as epistaxis will replace menstrual bleeding when occurring at or just before a period.

Troublesome hæmorrhage is liable to attend operations upon patients suffering from *jaundice*, but whether in the case of tooth extraction this has ever given rise to any serious alarm I am not prepared to say, nor have I heard of any recorded case.

Hæmophilia is by far the most important of the constitutional conditions that may be present at the time of the extraction of a tooth, or during any operation involving the cutting or division of bloodvessels.

There can hardly be any exception to the rule that the **extraction of teeth must never be undertaken in hæmophilic patients.**

No doubt the timely removal of a tooth will occasionally obviate the necessity of a subsequent cutting operation which would involve a like risk to that of removal of the tooth—*e.g.*, pus arising from a lower posterior molar, and tracking under the deep cervical fascia down the neck towards the mediastinum, or bursting into the antrum from an upper premolar or molar root. As these sequelæ cannot be foretold, in most cases it would be safer to allow the pus to burst spontaneously, taking the risk that it may open in an unfavourable position, as there is no doubt that the liability to hæmorrhage from an abscess which has burst spontaneously is far less than from one opened by the surgeon.

All recorded cases of large operations—*e.g.*, amputations, ligature of vessels—have ended fatally, either of bleeding from the operation wound itself or of bleeding for the relief of which the operation was undertaken (Wickham Legg).

The removal of a tooth, although a trifling operation, carries with it special risks, and in hæmophilia the magnitude of the operation bears little or no relation to the seriousness of the hæmorrhage which may follow.

The divided vessels in the alveolus of the socket of a tooth cannot readily fall together, and before bleeding can cease they must be plugged by a thrombus.

The warmth of the mouth and the suction of the latter, as mentioned previously, also tend to prolong the bleeding. On the other hand, the socket of a tooth, from a mechanical point of view, is favourable for plugging; but the latter is only of use in aiding coagulation of blood by causing stagnation, and where the power of coagulation is diminished, or almost absent, bleeding will continue whether a socket be plugged or not.

The removal of a tooth, however desirable from other points of view, must be put aside in favour of other treatment. In most cases an aching tooth can be relieved by local measures applied to the tooth itself, and in those cases where suppuration results this is better left to discharge itself rather than run a risk of uncontrollable, and often fatal, hæmorrhage.

However, there are some cases where not only is there a risk in leaving suppuration, but the patient's condition is for the time being such a deplorable one that some relief must immediately be given, and such a condition frequently arises from suppuration around a lower third molar, infiltrating the masseteric and pterygoid regions, and leading to closure of the jaws. The patient is prevented from sleeping and eating, and is in great discomfort, both from the tense swelling of the face and jaws and also from the inability to cleanse the mouth, which becomes very foul.

In such a case it might be justifiable to pass a large hypodermic needle into the swelling, drawing off some

of the pus, and allowing the rest to escape through the puncture.

The subjects of hæmophilia, however, rarely live to an age when troubles from the posterior molar teeth arise.

An exception to what has been stated above can be made in the case of females who are almost exempt from *traumatic hæmorrhages*.

Hæmophilia generally first shows itself towards the end of the first year, when a child learns to walk, and so becomes liable to traumatism, and rarely after the tenth or twelfth year, so that to some extent any alarming symptoms from this disease are liable to occur during the first and second dentitions.

As regards its *ætiology*, there are no external peculiarities in the subjects of hæmophilia, and patients frequently show considerable intellectual ability. The disease is much more frequent in boys, occurring in the proportion of eleven to one in males as compared with females, and the danger to life in females is much less than in males. The disposition may limit itself in this sex to occurrences of spontaneous hæmorrhages, or ecchymoses, or to early, abundant, and prolonged menstruation.

In about half of the cases (fifty-two in ninety-eight) there is a history of a disposition to hæmophilia in parents, grandparents, or cousins.

Intermarriage of near relations may favour the disease, and this is to some extent borne out by its apparently more frequent occurrence in Germany and among Jews.

The relation of gout and the influence of emotion are doubtful, but are said by some authors to have some importance.

Daughters of a bleeder family are to a great extent protected against hæmophilia, yet possess the faculty of transmitting hæmophilia to their sons.

This mode of *hereditary transmission* is not peculiar to hæmophilia; there is a similar tendency in gout and other diseases. Curiously, in a large proportion of cases a history of gout can be obtained in the parents.

There is said to be uncommon fertility of women belonging to bleeding families.

Hæmophilia does not occur in the lower animals.

Symptoms may show themselves in foetal life, as in two recorded cases, in one of which bruising on the forehead and in the other extravasations over both shoulders were present. They may also occur in early life, during circumcision; but, as a rule, symptoms do not appear until towards the end of the first year, and these have been conveniently divided into three degrees:

First Degree.—This is the most typical and characteristic form. There is a tendency to every kind of hæmorrhage—traumatic or spontaneous, interstitial or superficial—also effusions into joints.

The disease in this form is rare in women.

Second Degree.—The hæmorrhage here is less intense, and occurs as a spontaneous bleeding from mucous membranes only.

This condition occurs in women, and only occasionally in boys and men.

Third Degree.—A liability to spontaneous ecchymoses may be the only indication of this disease, and in these cases it is almost invariably confined to women.

Spontaneous bleedings, of which epistaxis is the most common and fatal, are occasionally preceded by prodromata three or four days before the onset, and consist chiefly of signs attributable to plethora.

The same kind of wound may at one time be followed by natural bleeding, and yet be fatal from profuse bleeding at some subsequent period. The same hæmorrhage

also, or that from another part, may alternate or continue with varying intermissions until fatal, or, again, alternation of healing and bleeding may ensue. Probably this disposition to bleeding varies at different times.

The bleeding is very common on the slightest cause, or without any apparent warning, and is capillary, the blood trickling away as if pressed from a sponge, and lasting a few hours to as many weeks.

In one recorded case bleeding was fatal in six hours from the onset, and in another not until the bleeding had lasted eighteen weeks.

The bleeding does not always follow a wound, and the latter may be well on its way to healing before the hæmorrhage occurs.

Spontaneous or traumatic bleeding when excessive can seldom be at once checked by any means hitherto recommended. It will occasionally cease on fainting, but there is a danger of its renewal on return to consciousness, and such blood lost is only gradually regained after many months.

There are no constant **morbid appearances** present in hæmophilia, and apart from the anæmia, the presence of petechiæ and ecchymoses, there is nothing to indicate the nature of the disease.

The **diagnosis** in a well-marked case rarely presents any difficulty.

A history of repeated severe hæmorrhages from early infancy, especially when following trivial injuries, effusion of blood into the larger joints from time to time, and the existence of a hereditary predisposition to bleeding, will make the diagnosis almost certain.

Spontaneous bleedings are not of so much importance, as these are common in boys before puberty.

The **prognosis** in these cases depends upon the duration

and amount of bleeding. Age, sex, and previous health also influence its gravity, and in traumatic cases the kind of wound present, bleeding from lacerated wounds, or those following the extraction of teeth, are unfavourable, while of the spontaneous hæmorrhages epistaxis is the most dangerous.

With regard to **treatment**, the preventative measures are by far the most important when the disease is recognized, and the rule that *no cutting operation* be undertaken unless the patient's life be in danger for want of that particular operation, and for which no other can be substituted, applies equally to that of extraction of teeth.

However, should the removal of a tooth be undertaken, unaware that the patient is the subject of hæmophilia, and profuse and continued bleeding follows, the wound must be cleansed and treatment directed to bringing about a rapid coagulation of blood and a firm clot.

Styptics are almost useless in these cases, and probably when apparently successful the bleeding has stopped of itself. Ergot may be of some use in contracting the arterioles, but unless an internal clot is also formed, this will have but little effect. This drug is useless in capillary bleeding.

Calcium chloride (grains 10 to 20) in the form of a coated pill or enema, or applied locally in solution (1 per cent.) on a tampon, is probably the most effective of the drugs, but retards coagulation if a certain percentage of calcium has been exceeded.

It has been suggested that by *increasing the number of white blood-corpuscles*, and so the amount of tissue fibrinogen, a substance essential in the coagulation of blood, some help may be provided towards clotting. This has been carried out by administering substances rich in cellular elements—*e.g.*, yeast, sweetbreads, kidneys, etc.—but it is

doubtful whether their properties are not destroyed in the process of cooking.

Cold, in the form of ice-compresses or ice-bags, should be one of the first of local remedies to apply. Failing with this, a graduated *compress* used dry or soaked in tannic acid and glycerine, and firmly kept in position without, if possible, *fixing the jaws*. Such compress should be allowed to work out by itself, the mouth in the meantime being kept as clean as circumstances permit, or else the plugging will become very foul and predispose to secondary hæmorrhage.

A further objection against fixing the jaws, besides rendering cleanliness of the mouth difficult, is that bleeding may continue after plugging without any external indications, the method having been only successful in as far as obscuring the hæmorrhage from view.

Suturing the lips of a socket is not likely to be effective here, as in dealing with cases of excessive hæmorrhage dependent upon a local and not a constitutional cause; and if employed, the sutures should be passed deeply across the socket and the surface of the wound, afterwards compressed by folds of lint or gauze, kept in position by a wedge of wood or other material, between the adjacent teeth.

As a last resource, the *cautery* may be applied; but all active local treatment is better avoided, as, even if effective, bleeding is liable to result after the separation of the sloughs.

Pressure on a main artery supplying the part is inadmissible, the necessary bruising being followed by ecchymosis, and its effects only lasting as long as the pressure is applied.

Infusions of warm saline solution or other bland fluid is of use in temporarily replacing blood lost, but will require repeating if bleeding continues.

In addition to the above, *the patient must be kept quiet, his head raised, and body well wrapped up in blankets.* He should only be given a *slop diet* for several days, although this must be nourishing and in sufficient quantity to keep up the patient's strength. All liquids must be given cold as long as bleeding continues, and only gradually warmed after this.

Alcohol should generally be withheld while bleeding continues, and afterwards regulated by the pulse.

Between attacks cod-liver oil is useful for children. Warm clothing, cold bathing, and a dry and bracing climate are recommended, while all games except the very quietest should be *absolutely forbidden.*

Further information on this disease can be obtained by referring to an excellent monograph on the subject by Wickham Legg, and subsequently epitomized in Clifford Allbutt's "System of Medicine," 1898. Only sufficient has been mentioned here as an aid to diagnosis and treatment.

In cases where *excessive bleeding* follows tooth extraction in the absence of the above-mentioned unfavourable conditions, the treatment is much more satisfactory, and local measures are generally effective in controlling the hæmorrhage.

Blood in a healthy person tends to coagulate within five minutes of leaving the vessel wall. The latter is innervated from the vaso-motor centre in the medulla and maintained in a constant state of tension or contraction, commonly known as tone, through its muscular coat. When an artery is divided, the longitudinal tension being removed, the muscular coat contracts and curls up, carrying with it the internal coat into the lumen of the vessel; the external coat contracts independently through its contained elastic

fibres. The walls of capillaries and veins tend to collapse as soon as the blood ceases to circulate in them.

When from some cause or other the above changes do not readily take place, and bleeding continues, treatment directed towards the arrest of this bleeding becomes necessary.

Ordinary, or what may be termed normal, hæmorrhage following tooth extraction requires no further treatment beyond allowing the patient to emit all the blood from the mouth and keeping the latter subsequently clean.

Before considering the treatment of *excessive hæmorrhage* following tooth extraction, it will be necessary to briefly mention Nature's means of arresting hæmorrhage, as by a knowledge of this both the cause and the treatment may become apparent.

The **natural arrest of hæmorrhage** is brought about by processes which for convenience are divided into *temporary* and *permanent*, or early and late. All artificial means should be directed towards aiding the former.

The permanent arrest of hæmorrhage consists in changes compatible with those of repair of tissues, over which we have little or no control.

The temporary arrest of hæmorrhage is brought about by certain conditions, which may be classified into general and local. In the slighter cases the latter are probably the more important, the former only participating to any extent in the severer forms of hæmorrhage.

Local Conditions which aid in the Arrest of Hæmorrhage.

1. The *external clot* which forms within the sheath of the vessel wall, acting as a buffer at the open end of the vessel.

2. The *internal clot* which is formed within the vessel wall, extending from the external clot to the last patent branch, and depending upon the efficiency of the external clot for its formation.

3. *Retraction* and *contraction* of the artery within its sheath.

General Conditions which aid in the Arrest of Hæmorrhage.

1. Diminution in the *force* of the heart's action.

2. Increased *coagulability* of the blood after severe hæmorrhage.

3. Rest consequent on *syncope* arising from the loss of blood.

Hæmorrhage is for convenience divided into :

1. *Primary*.

2. *Recurrent, reactionary, or intermediate*.

3. *Secondary*.

1. *Primary hæmorrhage* is that hæmorrhage which results immediately from a lesion of a bloodvessel, interrupting its continuity, and may arise from an open wound or be subcutaneous.

2. *Recurrent hæmorrhage* arises from the failure of Nature's or the surgeon's methods of temporary arrest of hæmorrhage—*e.g.*, the displacement of a blood-clot, the slipping of a ligature, the loosening of a plug in a tooth-socket, etc.

3. *Secondary hæmorrhage* results from the failure of Nature's methods of permanent arrest of hæmorrhage.

Hæmorrhage following tooth extraction may come under

any of the above headings. The conditions necessary for the occurrence of *recurrent hæmorrhage* are the increased action of the heart, following upon its temporary depression from loss of blood or syncope, dislodging the blood-clot occluding the lumen of the vessel or the surgeon's ligature or plug. In the case of the mouth, these conditions are favoured by the patient assuming the recumbent position, and together with the warmth of bed probably account for the frequency of hæmorrhage occurring at this period after the operation.

Secondary hæmorrhage is now less usual than formerly, and probably the mouth is the commonest position for such hæmorrhage on account of the great difficulties of obtaining *asepsis*.

Hæmorrhage occurring from wounds in hæmophilic patients naturally comes under the term of 'primary hæmorrhage,' and even when spontaneous some lesion is probably present, although this may be microscopic.

Treatment of Excessive Hæmorrhage following upon Tooth Extraction.

A good light must be thrown into the mouth—daylight where possible, otherwise reflected artificial light—and a *clear view* of the bleeding spot obtained. If necessary, wash away any loose blood-clots with a stream of cold water, or where adherent, gently wipe away with a sponge.

When the source of hæmorrhage is detected, allow the wound to become freely *exposed to the air*. This exposure is an excellent hæmostatic, and alone is often sufficient to stop the bleeding in the slighter cases of continued oozing.

At the same time the *character* of the bleeding must be observed, as both its site and character will help in determining the subsequent treatment to pursue.

On *no account* should a socket be at once plugged before this and other means are first taken. To immediately plug a socket obscures the loss that is taking place, and prevents rational means being directed towards its cause.

Frequently I have seen cases where bleeding has continued solely through meddlesome treatment, plugging, styptics, hot and cold water being used alternately or together, regardless as to why the bleeding continued, and aimless in its method of prevention; when on removal of bits of lint, gauze, cotton-wool, or other plugging material, and allowing the wound to become exposed to the air, bleeding ceased within a few minutes.

So that in a large number of the slighter cases of hæmorrhage free exposure of the wound to the air will be sufficient to arrest the bleeding if during the same time the patient assumes the *semi-recumbent position*, remains quiet, and refrains from constantly spitting out blood.

The blood should be allowed to collect and trickle out of the mouth into some vessel held close under the chin, or at the most occasionally washed away with a little cold water, *avoiding the suction action* associated with the more violent forms of emission.

During this time the amount of hæmorrhage can be roughly gauged by noticing how often it is necessary for the patient to empty the mouth; but it must be remembered that the amount of blood lost is always more apparent than real. A few drops of pure blood will colour an ounce or more of saliva to almost a claret colour, and the actual presence of blood in the mouth causes salivation.

After about half an hour, if blood is still oozing from the socket, more active measures will probably be required, although in most cases the hæmorrhage would cease of its

own account before many ounces of blood were lost, if the patient could only be watched during that time.

The wound should be once more carefully examined, noticing whether the hæmorrhage is as copious as previously, the presence of fresh clots, and from other conditions forming an idea of the best treatment to pursue.

As hæmorrhage is more liable to follow from a damaged socket, the latter should be carefully examined for loose portions of tooth or alveolus, which should be *removed*, together with pendulous portions of gum if obscuring the view, or in other ways hindering treatment.

When *syringeing a socket with cold water* has failed, the application of ice, either loose or in the form of an ice-bag, would probably likewise be inadequate even if immediately obtainable.

Farmer has recently suggested an adaptation of Leiter's tubes to the buccal cavity for internal fomentation in inflammatory conditions, and possibly this method might be also successfully used in conveying cold to the gums.

Hæmorrhage still continuing, pressure in some form or other over the bleeding area becomes necessary, and one of the best ways of carrying this out is by *plugging a socket*.

For this purpose narrow strips of ribbon boracic gauze—*i.e.*, gauze with non-friable edges and about $\frac{1}{4}$ inch in width, according to the size of the socket—are most convenient. These strips may be advantageously soaked in a solution of adrenalin (0.1 per cent.).

The gauze must be packed firmly into the socket to the level of the gum, using one long strip when possible, as a tighter plug can in this way be obtained, and its subsequent removal more easily effected, and with less liability to disturb any clot after bleeding has once ceased.

Gauze saturated with blood often closely resembles blood-clot, and if in mistake the latter be disturbed fresh hæmorrhage may occur; whereas, when only one piece of gauze is used, the end of which is left projecting from the wound, this mistake will not occur.

It is most important that the deeper portion of the socket be very firmly packed, the integrity and so the success of the plug depending on this portion.

After plugging the socket, the neighbourhood of the wound must be closely examined to see if all bleeding has ceased, or is likely to cease with the increased pressure gained by *fixing the jaws*.

To fix the jaws by bandaging directly after plugging the socket, or sockets, without previously ascertaining how far such plugging has been successful in controlling the hæmorrhage, will only court disaster by obscuring from view any subsequent bleeding that may take place.

If the plugging has completely arrested the hæmorrhage, a firm pad of gauze is laid across the wound to the level of or above the adjacent teeth, according to the bite, or in edentulous cases so that the opposing gum is driven well into the gauze. The jaws are then firmly closed and bandaged.

When the plugging has been only partially successful in controlling the hæmorrhage, it should be removed and reapplied with firmer pressure; but if bleeding still continues, although diminished, further layers of gauze should be packed over the socket and the jaws brought together as above, in the hope that the extra pressure gained may be sufficient to completely arrest the hæmorrhage.

The patient must be watched for at least an hour after all bleeding has ceased, and, further, must be directed as to feeding, sleeping, and general care of himself. He must also be informed of what steps to take should bleeding recommence.

With regard to *feeding*, only cold liquid food is permissible, and this is best taken in the form of milk, beef-tea, or one of the essences of meat containing the extractives. Stimulants and hot drinks are to be avoided, as by causing a dilatation of the peripheral vessels they encourage bleeding by dislodging the temporary clots formed in their open lumina.

It is better for the patient to refrain from all liquid food for some hours, especially where the teeth must be slightly separated for this purpose.

The patient must remain quiet, in a semi-recumbent position, and *during the night his head and shoulders kept slightly raised*, with a firm cushion beneath the pillow, and his body kept warm.

Within twenty-four hours the patient should be again seen, the bandages removed, and the mouth gently opened.

In favourable cases firm clots will be seen around the wound, and adherent to both sides of the jaws, so that they often stretch, still retaining their connexions, even when the mouth is opened.

When this condition is present, there need be little fear of hæmorrhage restarting.

After carefully removing the superficial pad of gauze, the wound should be inspected, and the plugging in the socket allowed to remain if there seems doubt that in its removal fresh bleeding may occur. As this deeper portion of plugging has been covered in and excluded from the saliva and fluids of the mouth, it can be safely left *in situ* for another twenty-four hours if desirable.

Now that the jaw is no longer fixed, the mouth should be occasionally washed out with some weak antiseptic, and the remaining plugging kept as clean as possible.

On the second day the plugging will be found slightly loosened, and can be carefully withdrawn without much fear

of further hæmorrhage, the socket kept clean and allowed to granulate ; whereas, if several portions of plugging had been used, the socket would be disturbed in removing each separate piece, possibly causing fresh bleeding.

It is better, where possible, to retain the plugging by a wedge of wood or vulcanite between the adjacent teeth, rather than binding the chin to the head, as by the former method the mouth can be kept cleaner, and at the same time watched to see that no further bleeding takes place.

Further, the warmth of the mouth in the latter case probably tends to encourage bleeding.

Some authors still advise plugging a socket with matico-leaf, and mention good results from its use. However, gauze is a more adaptable material, and the astringent action of the former can be obtained by impregnating with various drugs.

Styptics are rarely successful by themselves, except in quite slight cases of hæmorrhage, but may be combined with plugging if desired.

Using the extracted tooth as a plug has been suggested, and found useful in troublesome cases of hæmorrhage.

Its adaptation for this purpose should be ideal where the socket is not injured. If the tooth is healthy and has not been subsequently contaminated, there can be no objection to its use. The jaws will still require to be fixed, interposing a pad of gauze between the opposing teeth on that side ; or the tooth covered over with the gauze might be introduced into the socket in a similar way to a petticoated tampon, the free ends of the gauze rolled up and made to form a pad over its crown, into which the opposing teeth are driven when the jaws are fixed.

Suture is a method not much used. No doubt its applicability for controlling hæmorrhage from a bony socket is not so great as when raw surfaces of soft tissues

can be brought into direct apposition. Its use in the latter case has been mentioned in connexion with wounds of the cheek, lips, and tongue; however, when combined with plugging, it is sometimes an excellent means of controlling hæmorrhage.

After the socket is firmly plugged its lips are brought together with moderately stout silk over the plugging, and securely tied. As much of the free mucous membrane as possible must be taken up in the suture on either side. Two or three sutures are generally sufficient to firmly approximate the lips of the socket.

A small, fully curved Hagedorn needle is best adapted for this purpose, and must be introduced into each lip separately, where there is projection of the alveolus.

The above method will often do away with the necessity of fixing the jaws and its objections.

Occasionally, from projection of the alveolus or scantiness of the free mucous membrane, this method cannot be adopted.

Another method which I have found useful on a few occasions consists in using the same means as above, but in a reversed order, and is applicable to those cases where fairly broad raw surfaces can be approximated.

The lips of the socket are brought together with two or more silk sutures, the tied ends of which are left long so as to be subsequently brought round a firm narrow pad placed across the socket, and the knots secured over this pad. The patient is then directed to bite well into the gauze pad, and the chin is bandaged to the head.

This method has the advantage that when hæmorrhage has apparently ceased the pressure can be removed gradually, and so with less risk of inducing fresh bleeding. The jaws may first be released and the mouth inspected. If no further bleeding has occurred the pad may next be

removed by snipping through the silk loops surrounding it, the wound being still approximated by the tied silk sutures. It is generally desirable to leave these for two or three days, or allow them to work out by themselves.

As there is no plugging in the socket itself, when the silk sutures come away the wound will be found almost healed.

Suturing by itself is more adapted when the soft tissues alone are involved—*e.g.*, in injuries to the mucous membrane of the lips, cheek, and tongue. But when a cavity, as a socket of a tooth, has to be obliterated, stitching the mucous membrane across it will be ineffective in stopping hæmorrhage, unless combined with one of the methods above mentioned.

Gauze should seldom be left in the mouth for more than twenty-four hours, and this should be the extreme limit where the jaws are fixed, preventing oral cleanliness.

With regard to the treatment of hæmorrhage by *drugs*, these, when used locally, are mostly of the nature of vegetable or metallic styptics, and include cold applications, salts of lead, copper, silver, zinc, iron, bismuth, hamamelis, ergot, tannic acid, alum, dilute sulphuric acid, etc.

Some styptics arrest hæmorrhage by causing *contraction of the muscular coats* of a vessel—*e.g.*, cold, salts of lead and silver, alum, hamamelis; others by *coagulating the albumen* both in and around the vessel walls—*e.g.*, tannic acid and substances containing it, salts of lead, silver, zinc, copper, iron, bismuth, alum.

Some of the above-mentioned drugs act on the muscular coat of the vessel, as well as coagulating its contained albuminous fluids—*e.g.*, the salts of lead and silver.

In the case of tannic acid, the proteid-tannate which is precipitated is soluble in excess of albumen, so that before

applying tannic acid in any form for arresting hæmorrhage it is necessary to remove all blood-clots, and allow the drug to come into direct contact with the bleeding spot.

Proteid-tannate is also soluble in excess of acids or alkalies, so that its use after most other drugs is inadmissible.

When used pure or in strong solutions an immediate superficial precipitate occurs, thus preventing its penetrating to the lumina of the vessels when there is much exudation or blood around.

Matico-leaf is a hæmostatic in that it presents an uneven surface to the blood flowing over it, so favouring retardation and coagulation—*i.e.*, from its physical properties rather than any inherent quality.

Adrenalin, the active principle of the suprarenal gland, is obtained from a watery extract of the freshly dried glands of the sheep or ox.

The solution may be sterilized by boiling.

This drug does not come under the above classification, but might be included with vegetable styptics, under the term of 'organic styptics,' the inorganic being represented by the metallic.

When injected into a bloodvessel the effect of adrenalin is somewhat similar to that of digitalis, and its action is probably both on the medulla and directly on the muscular coats of the arterioles. The former is indicated by the slowing of the pulse and the sustained and strengthened systole of the heart; the latter by the marked *contraction of the peripheral arterioles*.

The local action of adrenalin is well seen in perfusing a mixture of blood and the extract through the vessels of an excised organ. The mixture passes through the organ and escapes less rapidly than when pure blood alone is perfused. Or, again, by the marked contraction

of the vessels of the mesentery when adrenalin is applied directly to them.

The action of adrenalin on different varieties of involuntary muscle in opposite ways—*i.e.*, constriction and inhibition—similar to the stimulation of sympathetic fibres, has given rise to the supposition that its action may be on their *nerve terminations* and not on their muscular fibres.

This view is, however, invalidated by the fact that its action persists after the degeneration of these nerve-endings.

The short duration of the effect of adrenalin on blood-vessels has been ascribed to its rapid excretion or oxidation, but this view is not supported by its *continued action* when allowed to enter a limb previously occluded by ligature, and after its effect has already passed off from those parts in which it has already circulated.

When used locally, adrenalin causes complete blanching of the tissues from contraction of the small arterioles, and its effects remain local.

Adrenalin may be combined with antiseptics—*e.g.*, carbolic acid—or with alkaloids of the nature of cocaine, when it is desirable to retard the absorption of these poisons so as to prolong their local effects.

The soluble salts of calcium are of doubtful use in the treatment of hæmorrhage, and are only absorbed internally with great difficulty.

Of the large proportion of lime taken into the body as food, only a small portion is absorbed, the rest leaving the body unchanged.

That which is absorbed probably enters into combination with the proteids and is slowly excreted, unless required by the tissues.

“The small quantity of calcium absorbed from the alimentary canal has not been shown to have any action,

except in replacing the calcium compounds of the tissues.”*

The calcium of the food is sufficient to supply the needs of the organism under ordinary circumstances, and any excess, as when lime salts are given as remedies, probably derive their activity from the acid radicle of the salt or anion, rather than from its calcium or ion.

Lime salts, however, are indispensable in some processes not depending on the presence of living cells—*e.g.*, the coagulation of blood. The latter may be prevented by precipitating its calcium salts by oxalates.

Fibrin ferment is not formed except in the presence of calcium salts, but when once formed lime salts are not necessary for the further formation of fibrin, for this will occur in oxalate solutions if fibrin ferment be added to fibrinogen (Hammerstein).

“In other words, lime is not necessary for the activity of the fibrin ferment, but for its development from the prothrombin or zymogen, in which condition it exists in the circulating blood.”†

The prothrombin or mother ferment is believed to be derived from the white blood-corpuscles.

The part played by calcium salts in the coagulation of the blood may be graphically represented by the following formula :

Prothrombin + calcium salts (plasma) = thrombin (fibrin ferment) ;

Thrombin + fibrinogen = fibrin + fibrinoglobulin (a soluble globulin).

Clotting of blood starts from fine granular masses of protoplasm, derived either from white blood-corpuscles or

* Cushny, “Text-book of Pharmacology.”

† *Ibid.*

possibly from the blood-platelets. These masses under the microscope have the appearance of meshes in a net, the filaments representing the commencing clot.

Lime salts have been suggested as a remedy for those cases of hæmorrhage in which the blood seems less capable of clotting than normally—*e.g.*, hæmophilia.

However, as stated above, more lime is taken into the body as food than is required by the organism, so that it seems improbable that coagulation is retarded on this account.

Gelatine administered internally or hypodermically has recently been suggested for the treatment of hæmorrhage, and experiments seem to indicate that the coagulation of the blood is hastened by gelatine, although these experiments have not since been confirmed.

Aneurisms have been treated in this way with doubtful benefit.

Some of the above-mentioned drugs are also used for their general effects—*e.g.*, hamamelis and lead salts. In addition, there are others used solely for internal administration; these, by acting on the *vasomotor centre* in the medulla, cause contraction of the vessels—*e.g.*, digitalis series, including strophanthus and squills; ergot, hamamelis, strychnine, hydrastine, and hydrastinine.

Digitalis, however, is not used in arresting hæmorrhage, as the increased blood-pressure it produces would antagonize the advantage gained by the constriction of the arterioles, whereas adrenalin and other drugs, used locally, produce the vaso-constriction without the accompanying rise of blood-pressure.

Ergot, again, causes a rise of blood-pressure, but after a preliminary fall, and at the same time causes a general constriction of arterioles and of unstriated muscle in other parts.

Its effect on hæmorrhage from the gums is not so marked as in hæmorrhage from muscular organs like the uterus, where both the constriction of the unstriated muscle of the organ and of its vessels help in occluding the latter.

When used it is best combined with perchloride of iron and dilute phosphoric acid, the use of the latter being to clarify the bluish or greenish-black precipitate resulting from the tannin contained in the ergot combining with the iron. Some flavouring ingredient must also be added.

Hamamelis is an astringent on account of its contained tannin (8 per cent.); it is also reputed to be a remote hæmostatic.

Strychnine is a vaso-constrictor, and also slows the heart rhythm by stimulation of the inhibitory centre in the medulla; however, its powerful tonic effect, producing raised arterial tension and increased muscular activity, precludes its use for arterial constriction alone.

Hydrastine and Hydrastinine.—Both these alkaloids cause a temporary rise of blood-pressure from constriction of the arterioles and slowing of the pulse. The rise, however, is not sustained, partly from their subsequent dilation, and from weakness of the heart brought about by direct action on the cardiac muscle.

Hydrastinine causes greater contraction of the peripheral vessels than hydrastine, and acts less on the heart. Its use has been, so far, almost confined to hæmorrhage from the uterus.

Opium and morphia are useful in *allaying the restlessness* following upon loss of large quantities of blood. These drugs are also useful in intestinal hæmorrhage, where they give local rest by stopping peristaltic movements, and so allowing blood to coagulate; their use, however, would rarely be required for alveolar hæmorrhage.

Having given a short account of the therapeutics of the drugs in most common use for the arrest of hæmorrhage, it will be necessary to briefly mention how these are best applied.

The value of the treatment of hæmorrhage by drugs is very difficult to gauge, as the tendency for hæmorrhage to become spontaneously arrested is so great, and as drugs applied locally are generally combined with pressure, what share each partakes is difficult to ascertain.

Local Astringents.—Both tannic acid and lead are conveniently applied combined with glycerine, the latter in the form of the sub-acetate.

The glycerine will allow the drug to come into more intimate contact with the bleeding surface, and prevent its being washed away so easily in the mouth, or it may be applied on the gauze used for plugging.

Tannic acid is also usefully applied, combined with collodion, in the form of styptic colloid (tannic acid 20 per cent.), the evaporation of the solvent leaving the surface covered with a thin layer of collodion impregnated with tannic acid.

Tannic acid, when applied directly to the bleeding spot, is best used in the form of the pure acid.

Adrenalin should be used in 0·1 per cent. watery or saline solution, and may be combined with cocaine, eucaine, carbolic acid, tannin, or other drugs, and applied on absorbent wool, gauze, or whatever material is used for plugging the socket.

Adrenalin is generally kept in saline solution, to which chloretone (0·5 per cent.) is added. The latter is a local anæsthetic paralysing the terminations of the sensory nerves, and is, in addition, an antiseptic.

The drugs commonly used *internally* are lead, ergot, iron, and calcium. Lead in the form of the acetate combined

with opium—*e.g.*, pilula plumbi cum opio; ergot as the liquid extract (extractum ergotæ liquidum), or the injection (injectio ergotini hypodermici, \mathfrak{m} 3 to 10). The latter is conveniently prepared from lamellæ (ergotin, grain $\frac{1}{3}$), dissolved in warm sterilized water, as solutions do not keep well; or the liquid extract may be used as an injection, deep into the muscles, as the drug is an irritant.

Iron is *incompatible* with all the vegetable astringents, on account of the intense black precipitate formed on its coming into contact with substances containing tannic acid or gallic acid. It is also incompatible with alkalies and their carbonates.

The perchloride and sulphate are the forms in which it is generally used locally.

The perchloride of iron should be combined with sulphate of magnesium when given internally, or the sulphate of iron with aloes can be given in the form of a pill—*e.g.*, pilula aloes et ferri (grains 5 to 10).

Its astringent taste may be concealed with glycerine.

The perchloride of iron should not be used as an injection, as the precipitated albuminate is liable to be carried off in the veins, causing embolism, and fatal cases have been recorded from its use in this way.

The perchloride is valueless in hæmorrhage from internal organs, very little is absorbed, and what passes into the tissues is already in proteid combination, and therefore incapable of assisting in the coagulation of blood.

Calcium is only absorbed with difficulty, and should be given in dilute solutions, as it is an irritant.

It should be administered for two or three days beforehand, up to a drachm of the liquor calcii chloridi in the twenty-four hours, but not pushed beyond this amount, or for long periods. Its action has been shown to have the *reverse effect* in large doses after prolonged administration.

In one case of hæmorrhage in which I gave the liquor internally, as well as packing the socket, hæmorrhage was soon arrested; but it remains very doubtful whether the latter method alone would not have been equally effective.

Drugs of the nature of *escharotics* should be avoided. They cause gangrene of the parts to which they are applied, and vascular dilatation of the surrounding area, and often increase, both in extent and depth, the area of the wound.

Tomes mentions two cases in which escharotics were used in the treatment of hæmorrhage. In both additional oozing resulted from the surrounding parts with which the drug came in contact. He also mentions a fatal case in which previously perchloride of iron had been used in this way.

The *actual cautery* used at a dull red or black heat has much the same action as an escharotic, but as it can be applied more directly to the bleeding spot without its effects spreading to the same extent, it has not all the objections of the former.

Both, however, are liable to be followed by secondary hæmorrhage when the sloughs separate, and more especially in the mouth, where asepsis throughout is difficult to obtain.

In one case I witnessed troublesome hæmorrhage following the removal of a fibrous tumour from the lower jaw almost immediately arrested by the use of the cautery.

In hæmorrhage from bone, as in the case of a socket of a tooth where bleeding vessels cannot be picked up and ligatured, should hæmorrhage continue after the above local measures have been applied, means must be directed to securing the bleeding vessel on its proximal side; and in the case of the lower jaw the inferior dental canal has been trephined, the artery exposed and plugged.

Tomes suggests, in preference to the above, as a less severe operation, division of the contents of the inferior dental canal by means of a drill in the dental engine, and subsequently plugging the cylindrical hole thus produced with a wooden peg.

Tomes adds that this operation would cause but little laceration, and in no way interfere with any subsequent treatment should failure result.

But I venture to suggest that unless a large drill were used and the surface marking for the canal accurately followed, there would be great difficulty in hitting off the artery by this method.

If *plugging the inferior dental canal* is ineffective in controlling the hæmorrhage, or where the uncontrollable bleeding is from the upper jaw, the only treatment remaining must be directed to the common carotid.

Compression of this vessel at the sixth cervical vertebra will probably have been tried before the operation of plugging the inferior dental canal, and where compression fails, *ligature* of this vessel would have to be considered.

After severe hæmorrhages, as those necessitating the ligation of a large vessel, the patient must be kept quiet in bed with his head low, the extremities firmly bandaged from below upwards, and the lower limbs raised off the bed. *Infusion* of warm saline solution either into a superficial vein or into the loose connective tissues will likewise help towards maintaining the heart's action and restoring the patient's strength.

CHAPTER III

EXTRACTION OF TEETH UNDER ANÆSTHESIA

WHEN performing the operation of extraction under an anæsthetic, we may have to *modify* to a considerable extent the rules that we have laid down for the process in general. As this has in the present day become a very important branch of dental surgery, we feel that we may with advantage devote a chapter to its consideration.

Before applying the anæsthetic, the operator should decide in his own mind what he *intends to effect*, and should also take into consideration the fact that he may not be able to accomplish all he desires, and therefore what under the conditions had best be attempted first.

Thus, a patient may be desirous of having, say, three teeth removed: one has been causing pain, the other two, though diseased, perhaps not. In such a case, the one giving pain should, even though the least convenient to the operator for so doing, be first removed, for it would be distressing for the patient, on becoming conscious, to find his enemy still in permanence, and circumstances might contraindicate his taking the anæsthetic a second time.

If no tooth has been especially painful, we should, as a rule, remove *lower teeth or roots before upper ones*, to avoid the blood interfering with our view; *roots before whole teeth*, and *back teeth before front ones*, for the same reason.

And it is generally best, where much has to be done, and on more than one occasion, to confine the operation to *one side of the mouth* before proceeding to the opposite.

The above points refer chiefly to cases where nitrous oxide is the anæsthetic chosen, either from circumstances or necessity. Where a more prolonged anæsthesia can be procured, these points do not weigh so heavily.

In the preliminary examination of the mouth, every care should be taken to *avoid making the gums bleed*, or causing the patient pain or any unnecessary fear. Yet the inspection should be conducted most thoroughly, so that the position of the teeth or roots to be removed may be well pictured on the mind of the operator when the face is obscured from view.

If many teeth or roots are to be removed, it is a useful plan to have these *charted* on a slate or card, the latter for preference when a permanent record is required, or if the operation demands some subsequent visits for completion.

Notes can be made on this card if a tooth be fractured, or where there is doubt as to the existence of a root.

He should next select his instruments, taking care to have not only those most handy which he is sure to use, but also any which he may chance to require. These should be arranged in some *definite order* convenient to the operator himself; and it is a good thing always to adhere to the same order, whether few or many instruments be required. A fairly complete set comprises about ten instruments, and in addition it is desirable to have duplicates of those most commonly used—*e.g.*, upper and lower root forceps—so as to be able, temporarily, to replace any which are being sterilized, or have become contaminated from an abscess. These can be conveniently set out in an ordinary metal or glass instrument tray containing some antiseptic lotion.

A mouth mirror, tweezers, and examining probe must also be close at hand, and may be kept in the same lotion.

Dry sponges or swabs of cotton-wool must be placed within reach, or held by an assistant.

It is desirable to have all instruments, appliances, and drugs likely to be required by the anæsthetist near at hand, in the event of any of them being omitted in his own portable equipment.

We recommend the operator, especially the least experienced, after the insertion of the prop, to take a view of the mouth from the position in which he will have to operate, in order to enable him to see the exact relationship of the teeth to one another and the surrounding parts.

We strongly recommend, in operations with anæsthetics, the employment of *as few instruments as possible*.

Time is a very important element, especially in the case of nitrous oxide, and a few seconds wasted often render further administration necessary. But this does not mean that we are to attempt at any time to use an unsuitable instrument.

Those which we most frequently employ in such operations are the upper and lower root forceps, the form of hinge figured occupying the least amount of bulk (Figs. 37 and 38).

Besides limiting ourselves to as few instruments as consistent with safeness, the order of removal of teeth should be arranged as far as possible to *prevent unnecessary changes* of these.

It is scarcely necessary to say that time should be economized in every way possible besides that already mentioned, which refers chiefly to methodical habits. Thus the operator should be ready to take up his position as soon as the face-piece is removed, the instrument being left in the lotion up to this period.

The actual operating time should be spent in steady,

sound operating, and cannot be hurried beyond a certain point. A little well done is preferable to more done in a less satisfactory way, and the former will be rightly more appreciated by the patient.

Unless obvious signs are present indicating that the patient is regaining consciousness, it must be left to the anæsthetist to intimate when the operation should cease.

It is never well for the student to attempt extractions under nitrous oxide until he has acquired considerable dexterity in operating without it, otherwise he will rarely become a safe, cautious, and dexterous operator.

Each tooth or root must be *removed from the mouth* before the operator attempts to extract another. An exception to this may be allowed where a tooth or root loose in its socket, or lying on the gum, still remains firmly attached to the soft tissues. In these cases the tooth may be subsequently separated by scissors or lancet after the patient has regained consciousness and his mouth is free from blood.

When many teeth are being extracted, or from other reasons hæmorrhage is copious, the mouth and throat will require *sponging* out from time to time, and the head must be prevented from being thrown too far back, or else blood will trickle over the back of the tongue.

In extracting lower back teeth, care must be taken to *avoid pressing back the root of the tongue or depressing the jaw*, both of which will be deleterious to an anæsthetized patient.

The conditions which render extraction of teeth under anæsthetics rather more difficult than otherwise are briefly the following :

1. The patient's head must be more rigidly *kept in one position* throughout the anæsthesia—viz., that favourable for the anæsthetic used.

2. *Venous engorgement* occurring during anæsthesia, especially of the tongue and loose folds of the floor of the mouth, prevents a clear view of the teeth being obtained.

3. The importance of *preventing teeth from falling into the mouth* during anæsthesia. If such occurs, they must be carefully removed before the operation is continued. In dealing with upper back teeth, it may be a wise precaution to keep the first finger of the left hand behind the blades of the instrument, to form an inclined plane, down which the tooth will fall in the event of its slipping out of the blades. Some operators use the corner of a napkin held with the left hand behind the tooth for a similar purpose. This would form a better protection than the first method, but would appear cumbersome until the operator had become accustomed to its use.

The anæsthetist's spoon serves a similar purpose.

4. A mouth-prop or gag must be used to keep the mouth open, and in a small mouth this interferes to some extent with the *amount of space* available for the introduction of instruments.

The operation being completed, the patient's head should be pressed gently forwards, especially if there be much hæmorrhage, and a suitable basin held under the chin.

There are two reasons why failure at extraction occurs, even at the hands of those best qualified as operators. One of these is the *want of adaptability of forceps* for the variable conditions which present themselves, the other being the *relation of the roots of a tooth to the surrounding alveolus*; in some cases this may be of such a nature that it is a physical impossibility to deliver the roots intact. The necessary *haste* with which the operation has usually

to be accomplished is a further difficulty to be overcome. In connexion with the latter, the operator is not always fair to himself in choosing an anæsthesia which is the safest and pleasantest for his patient. Nitrous oxide will not always allow sufficient time for what may turn out to be a difficult extraction, and the operator receives the blame for what would have been an entirely successful operation had the duration of the anæsthesia been adequate.

Patients should be informed that there is no difficulty in removing any tooth, provided the time for doing so be adequate, but that we cannot always guarantee to remove a difficult tooth during a prescribed anæsthesia of half a minute or so.

There is no reason why the operator should suffer in such cases, and frequently it is his own fault that he does so.

Fortunately, with continuous administration of nitrous oxide, ethyl chloride, and improved methods of inducing local analgesia, this difficulty has been to a large extent overcome.

ANÆSTHETICS

ANÆSTHETICS may be divided into two main classes—viz., general, or respiratory, and local.

1. General Anæsthetics.

The anæsthetics usually employed in dental surgery are nitrous oxide, ether, and ethyl chloride, either by themselves or in various combinations.

Chloroform is rarely indicated, and if used, should never be administered to a patient sitting upright. The patient should be anæsthetized on a couch or bed, preferably at his own home.

Nitrous oxide is the most suitable by far for the majority of such short operations as the extraction of teeth, being almost entirely free from danger, and allowing of a return to consciousness with but little discomfort or after-effects.

If either air or oxygen be administered with the nitrous oxide, a slight increase in the available anæsthesia is procured, amounting in the case of oxygen to about ten seconds.

This absence of after-effects is not entirely dependent upon the briefness of inhalation, as these are still but slight and transient when anæsthesia is continued for five minutes or more, and three or four times the amount of nitrous oxide inhaled. No doubt a more important factor

is the unstable combination which nitrous oxide forms with the hæmoglobin of the red blood cells, and its stimulating action on the circulation.

A safe and rapidly acting anæsthetic is the desideratum for such cases, and this we have in nitrous oxide.

The choice of the anæsthetic for dental operations depends chiefly upon three factors, viz :

1. The patient.
2. The operation.
3. The anæsthetist.

1. *The Patient.*

As far as *age* and *sex* of the patient are concerned there are but few contra-indications to the use of nitrous oxide.

In young children only a brief anæsthesia can be obtained, but sufficient, as a rule, for the removal of one or more temporary teeth.

Infants rarely present themselves for dental treatment, but may be safely anæsthetized by nitrous oxide. Struggling must be restrained, and the case demand an anæsthesia of but a few seconds.

At the other extreme of life patients usually take nitrous oxide well, although the health and vigour of the patient are more important factors than the actual number of years.

Young adults and middle-aged people are good subjects for nitrous oxide anæsthesia.

Patients suffering from chronic *bronchitis* or advanced *phthisis* must be carefully watched, and undue cyanosis strictly avoided ; likewise sufferers from *valvular disease* of the heart, where the lesions are either uncompensated or insufficiently compensated to bear the extra strain thrown on the pulmonary circulation.

Patients the subjects of arterial degeneration (*atheroma*) and its sequences require great care, and the administration may give rise to much anxiety.

It is generally stated that nitrous oxide may be safely administered up to, within the last month of *pregnancy*, coughing and straining being avoided as far as possible.

2. *The Operation.*

Both the number and condition of the teeth, as well as their position, must be taken into account; likewise the condition of the mouth.

Roughly speaking, from *one to four teeth*, presenting no special difficulties, can generally be safely removed under one administration of nitrous oxide.

For *four or more teeth* likewise presenting no special difficulties, but only the element of time for their successful removal, prolonged nitrous oxide by the nasal method, or ethyl chloride, the latter especially in young children, will be found to give the most advantageous anæsthesia.

For a *difficult extraction*—*e.g.*, an impacted wisdom tooth, more especially if this be on the right side of the mandible and accompanied with trismus—nitrous oxide and ether is the anæsthesia for preference, allowing the operator to have full control of the patient's head, and at the same time the jaws can be more readily separated under this anæsthetic than with nitrous oxide alone.

The anæsthetist should inquire of the dentist what duration of anæsthesia is likely to be necessary, and the anæsthetic used must be determined partly on this factor and partly on the requirements which the case in question demands.

Luke* gives a table of various anæsthetics either used by themselves or in sequence with others, and states

* 'Anæsthesia in Dental Surgery,' p. 24.

roughly the *available anæsthesia* derived by their means, which I cannot do better than quote :

Nitrous oxide	...	...	...	35 seconds.
„ „ and ethyl chloride	...	...	90 to 120	„
„ „ (nasal method)	...	...	1 „	5 minutes.
„ „ and ether	...	...	1 „	10 „
Ethyl chloride	...	...	1 „	2 „
„ „ and ether	...	...	1 „	10 „
„ „ and C.E.	...	...	2 „	5 „
C.E. and ether sequence	...	3 to 10 minutes,	or	<i>ad lib.</i>
Local anæsthesia	...	...	...	As required.

3. *The Anæsthetist.*

The anæsthetist's choice of anæsthetic will be guided partly on what he may hear beforehand of the exactions of the case and temperament of the patient ; whether the operation is to be carried out at the dentist's house or elsewhere ; and if less experienced, which of the anæsthetics adequate for the case in question he is most familiar with.

Before commencing to anæsthetize a patient, it is necessary to see that both the *apparatus and drugs* to be used are efficient, and that *accessory requirements* are also at hand —*e.g.*, a gag, wooden mouth-opener, props, mouth-spoon, sponges and their holders, tongue forceps, hypodermic syringe, strychnine, adrenalin (0·1 per cent.), and amyl nitrite ; also a tracheotomy case containing a tracheotomy tube, scalpel, small retractors, dissecting and artery forceps, blunt hooks, and tracheotomy dilator (two-bladed).

It is hardly possible to discuss the merits of the various kinds of instruments mentioned ; briefly, efficiency and simplicity are the attributes of good surgical instruments, accompanied, as this usually is, with ease in cleanliness.

Attention should next be directed to the patient's comfort, adapting this as far as possible to the needs of the operator and anæsthetist.

It is assumed that the patient is already aware that an anæsthetic is to be administered, and that *at least two hours have elapsed since the last meal*. The latter should be moderate in amount, and plain, avoiding as far as possible fats and other rich things. It is advantageous to have the bowels emptied on the morning of the anæsthetic, and the bladder shortly before the administration commences.

For anæsthetics other than nitrous oxide, regime should commence a day or more previous to the operation.

The anæsthetist should take a mental note of the *patient's condition* before undertaking the administration, with reference to whether the patient appears active, healthy, and robust, or pale, weak, and anæmic. In the case of the latter, and preferably in all cases, this must be followed up by an examination of the heart and lungs.

Frequently the administrator is the patient's usual medical attendant, and is already familiar with his health, vigour, and temperament.

If the patient be subject to shortness of breath, palpitation, fainting fits, etc., or there be any doubt otherwise as to his health, his usual medical attendant should, if possible, be previously seen or communicated with, and advice obtained as to the advisability of the patient undergoing an operation or anæsthetic.

All tight clothing, such as corsets, belts, and collars, should be *loosened*, so that the chest, abdomen, and throat are in no way impeded during respiratory or, possibly, struggling movements.

The patient should sit well back in the chair, with the head and neck in a line with the body. The posture should be one of *muscular relaxation*, avoiding foot-pieces or other obstacles which cramp the body and allow of leverage should struggling movements ensue.

The position must be that which favours a satisfactory

anæsthesia, and, if necessary, can be altered during unconsciousness to meet the demands of the operator.

It is desirable to fasten an apron or towel around the patient's neck to prevent *soiling* of his clothes.

The mouth should now be opened and a glance taken to see that there are *no artificial teeth*, and to note the presence of artificial crowns, loose teeth or roots, or other impediments to the insertion of a prop or gag.

The prop should always be *fixed to a chain or cord* which hangs out of the mouth, and its free end attached to another prop or cork. When possible, it should be placed on the side of the mouth opposite to that on which the operation is to take place, and preferably behind the premolar region, or in any case no further forward than the canine teeth. The mouth should be well opened, but at the same time not stretched to the utmost, as this will put the masseters on the stretch and render the cheek rigid.

Naturally, where the prop can be so placed as to obviate the subsequent use of a mouth-gag, this is desirable, both from the point of view of economizing time during anæsthesia, and for allowing the anæsthetist both his hands for steadying the patient's head.

The patient is now requested to bite on the prop and close his lips as much as possible, the latter rendering the prop more secure and the adaptation of the face-piece more perfect.

If the patient has difficulty in opening the mouth from inflammatory œdema of the masseteric and pterygoid regions (trismus), either a gag must be inserted from the beginning and the face-piece adapted as well as possible over it, or the teeth separated by a small prop allowing of sufficient space for the subsequent introduction of the gag during anæsthesia.

Generally the mouth can be opened sufficiently wide to allow of the above, but, failing that, the mouth must be opened during anæsthesia by means of a wooden wedge followed by the introduction of a gag, the wedge being forced between firm teeth, preferably in the molar region.

A tooth the cause of much inflammatory œdema is usually somewhat loosened, and nitrous oxide alone will suffice in many of these cases; but if the tooth be firmly embedded, fragile or difficult to reach, a more prolonged anæsthesia will be required.

If friends express a desire to remain in the operating-room, this may be granted, previously explaining to them that patients while under nitrous oxide may present an unpleasant appearance, perhaps struggle and become noisy. However, it is better, after the administration has once commenced, to assume that they would rather wait in an adjoining room, and be informed at once when they can come in.

For the actual administration of these anæsthetics, and the dangers which may be incurred during their progress, the reader must consult a work on the subject. The above introduction, however, will suffice to indicate those accidents referable to the operation of extraction itself, or to the preliminaries for carrying out the same.

If a tooth drops from the forceps on to the root of the tongue, the patient's head should be immediately bent forward, and the operation discontinued until the tooth is recovered. Any attempt made to dislodge the tooth from this position with the finger may induce a deep inspiratory effort, resulting in the tooth passing into the air-passages.

When, however, the tooth lodges in the floor of the mouth or sulcus of the cheek, the finger may be swept round behind the foreign body, and the latter brought to

the front of the mouth and removed, the head being held forward during these manipulations.

In carefully following out the ordinary rules for extraction, **accidents** of all kinds can to a large extent be avoided. However, blades of forceps, props, and gags have been known to break, as well as teeth, and any of these may pass over the back of the tongue through the isthmus of the fauces, and partially or completely *obstruct the air or food passages*.

Foreign bodies of the above nature are not likely to cause complete obstruction in the same way as a bolus of food impacted at the entrance of the gullet, although, if unrelieved, inflammation would rapidly ensue, causing œdema of the glottis with complete blockage.

A heavy, smooth body, such as those mentioned, would in most cases find its way into the œsophagus and become lodged in some part of its course, giving rise to a fixed pain, aggravated by swallowing or coughing.

Some amount of dyspnœa is present, varying with the position and size of the object.

The foreign body may be spontaneously ejected into the mouth or pass into the stomach.

If the foreign body remains *impacted in the pharynx*, the mouth must be widely gagged open on the right side, and the finger thrust to the back of the pharynx, the foreign body sought for and removed. If this fails, a further attempt should be made with suitably curved forceps, aided by a good light if at hand. In most of these cases the nature of the foreign body will be known.

Where asphyxial symptoms are urgent and increasing, the air-passages must be immediately opened, and after the patient has been given relief, further attempts made at the removal of the foreign body.

Inversion, together with vigorous shaking of the patient,

has been effectual in dislodging a foreign body, and should be tried both before and after opening the air-passages.

If the foreign body has become lodged in the œsophagus, an attempt should be made to remove it with œsophageal forceps ; its presence and situation will have been previously ascertained by the passage of a bougie or by a skiagram, where time has allowed.

An emetic, such as a subcutaneous injection of apomorphine hydrochloride ($\frac{1}{6}$ grain) may be permitted when the foreign body is known to be small and smooth (Cheyne and Burghard).

The most common situation for foreign bodies to become arrested in the œsophagus are at its two extremities, and where it is crossed by the aorta—*i.e.*, the narrow parts of the canal. Should it safely negotiate these places, the pyloric end of the stomach is the next position likely to offer resistance.

If œsophageal forceps, coin-catcher, or an expanding probang fail to remove the foreign body, it may be pushed down into the stomach if known to be small and smooth, and, providing no further symptoms arise, may be allowed to pass naturally. The patient meanwhile should be kept quiet and take food of a pultaceous nature, the motions being examined until the foreign body is recovered.

If the foreign body should become *impacted in the upper part of the œsophagus*, œsophagotomy will be required ; whereas if it be *impacted towards the lower end of the œsophagus*, gastrotomy is recommended as an easier and safer operation. The latter operation is also indicated for a foreign body in the *stomach* which cannot be safely allowed to pass on through the gut, or one which is producing, or likely to produce, serious symptoms.

Teeth are the most liable of the above-mentioned foreign bodies to pass into the *larynx*, excluding blood and pus.

If causing total obstruction, death may result, unless treatment be very prompt.

Partial obstruction is evidenced by a sudden sense of suffocation, marked cyanosis, and dyspnoea, violent spasmodic coughing, and alteration in the voice.

During one of these spasms the foreign body may be ejected into the mouth; if not, immediate preparations must be at hand for opening the air-passages. In the meanwhile an earnest attempt at removal with curved forceps, guided by the aid of a laryngoscopic mirror, must be made, or, failing that, laryngotomy is performed, and the foreign body brought out through the wound or dislodged from below. A small, light body—*e.g.*, portion of a tooth—may become lodged in the *ventricle of the larynx* or some portion of the *trachea*. The former may be indicated by the shortness of the intermissions between attacks of spasmodic coughing, and requires a high tracheotomy or laryngo-tracheotomy, followed by dislodgment of the body from below. In the case of the latter, the foreign body may shift in its position with respiratory movements, causing spasmodic and urgent attacks of coughing, associated with dyspnoea. An extensive low tracheotomy should be performed, and the edges of the wound kept well open, in the hope of the foreign body being expelled during an attack of coughing. Failing that, attempts must be made to reach it with suitable forceps. Should it have passed into one of the *bronchi*, it will give rise to a dull pain behind the sternum, associated with shortness of breath, cough, and diminution of breath sounds; later, collapse of that portion of the lung supplied by the affected bronchus, producing dullness over a corresponding area.

Treatment will consist in a free, low tracheotomy, the wound of which is held open and attempts made to excite coughing. If the body is not expelled in this way, it may

be reached with long flexible forceps or stout flexible wire, bent in the form of a blunt hook, and aided by the finger passed into the trachea as far as its bifurcation.

The right bronchus being the larger, and the spur formed at its commencement deflected to the left of the middle line, is consequently more often the recipient of foreign bodies.

Irritation and inflammation follow the retention of a foreign body in a bronchus, and an abscess has been the means by which a foreign body has become loosened and expelled during a fit of coughing, or recovered externally by the empyema making its way towards the chest wall.

For the treatment of cavities caused by the lodgment of a foreign body in a bronchus, reference to some work on surgery should be sought.

Within recent years a direct method of diagnosing and removing foreign bodies from the air and food passages by bronchoscopy and œsophagoscopy respectively has been advocated, and many successful cases have now been reported.*

For these methods to be successful it is important to undertake the extraction at an early period.

The technique of these operations can only be briefly mentioned here.

As a preliminary to œsophagoscopy, the soft palate, pharynx, epiglottis, and entrance to the œsophagus must be brushed over with a solution of cocaine (10 per cent.); in some patients a small dose of morphine or a general anæsthetic will also be required.

Having localized the foreign body with a soft bougie, the œsophagoscopic tube is passed, if necessary using a

* D. R. Paterson, *British Medical Journal*, August 18, 1906, and February 8, 1908.

gum elastic bougie as a pilot; any excess of mucus is wiped away, and the exact relations of the foreign body ascertained. The latter is then grasped with straight laryngeal forceps, and withdrawn along with the tube. If the foreign body be too large to be removed in this way, a little manipulation, bringing its long diameter lengthwise, may allow of removal, or should this fail, œsophagotomy will be required.

For foreign bodies in the air-passages, laryngoscopy, tracheoscopy, or bronchoscopy will be required, according to the position of the foreign body.

For carrying out bronchoscopy the tongue, soft palate, epiglottis, and the interior of the larynx are first cocainized (10 per cent. solution); in children a general anæsthetic will, in addition, be required.

A Killian's tube is passed through the larynx into the trachea, any excess of mucus is removed with a saliva-pump, and cocaine applied to the lower air-passages. With good illumination the tube can be passed down the affected bronchus, and a very fair view obtained of the foreign body; Killian's long forceps are then passed down the tube, the foreign body seized and removed, together with the tube.

Direct examination of the lower air-passages may be carried out through a tracheotomy wound where that exists (lower direct bronchoscopy).

A tooth may be loosened or dislodged in introducing a gag. Unless the tooth was previously loose, this is quite an avoidable accident, and usually results from the gag being inserted roughly or placed in the front of the mouth, one or more of the incisor teeth being sprayed out or entirely dislodged. A similar accident may occur through the use of a central prop. In either case the loosened or dislodged

teeth must be immediately reinstated, in the latter case after previously cleansing.

The insertion of a gag may also be responsible for *bruising of the lips, gums, or other adjacent soft parts*. The first of these usually occurs through the lower lip not being sufficiently depressed before the introduction of the gag. The lip gets carried over the lower teeth by the gag, and nipped when opened.

I have seen scar tissue at the angles of the mouth, caused by a burn, tear when the mouth was put on the stretch, necessitating a suture on either side.

2. Local Anæsthetics.

Local anæsthesia has in recent years increased in favour to such an extent, and still offers further scope for its development, that this small manual would be incomplete without a brief reference to this subject.

It is chiefly owing to improved technique that this method has been brought to the front within recent years.

Although, no doubt, for dental practice, local anæsthesia is capable of being put to many purposes, and has the prospect of further increase in the future, at present it is not destined to displace general anæsthesia.

General anæsthesia is still preferable for most children, nervous and excitable men and women, as well as for those cases presenting obstacles to the technique of the operation itself—*e.g.*, trismus of the jaws, suppuration, etc.

Local analgesia may be obtained in the following ways:

1. Drugs painted or sprayed over the area desired to be rendered insensitive (*superficial anæsthesia*).

2. Drugs injected into the desired area (*infiltration anæsthesia*).

3. Drugs injected into the spinal theca (*spinal anæsthesia*).

4. Drugs injected into the sheath of nerve trunks (*neural anæsthesia*).

For the extraction of teeth infiltration anæsthesia is that usually employed, although for loose teeth and roots the first method will often suffice.

The advantages of local anæsthesia for the extraction of teeth are—

1. There is *no need for any assistance*, the operator controlling both the analgesia and the extraction.

2. The analgesia lasts for an hour or more, so that the *operator is in no way hurried*, and the patient is spared a good deal of the after-pain resulting from extraction.

3. Almost, if not entire, *absence of after-effects*.

4. The apparatus required is *simple, cheap and portable*.

5. *No preparation of the patient beforehand is required*—in fact, it is advisable for the patient to have a meal shortly before the operation.

The advantage of general anæsthesia is that it is *more reliable*, although I believe local analgesia fails chiefly through want of technique being faithfully carried out. Undoubtedly, however, general anæsthesia has the advantage in that the patient is *unconscious of the operator's efforts* and manipulations, as under local analgesia these can be felt, although not giving rise to painful sensations.

Where it is necessary to only produce a superficial anæsthesia of the mucous membrane, drugs of the nature of cocaine and its salts, or any of the drugs commonly injected used in stronger solutions, will usually suffice.

Drugs the evaporation of which causes such intense cold that the parts subjected to their influence become

bloodless and lose their sensibility are occasionally brought into use for this latter purpose—*e.g.*, chlorides of ethyl and methyl, ether, etc. The anæsthesia, however, is superficial and transient, applicable only to a few cases, and produced in these with some amount of discomfort.

Method of Application of Refrigerating Agents.

1. The gums should be dried, and the area to be rendered insensitive shut off as far as possible from the surrounding parts by a cloth, cotton-wool, or other suitable material.

2. The spray should be conveyed in a small jet and continued until the gum is rendered white on both sides, and over an area well beyond that occupied by the tooth. The gum should remain in this bloodless condition for a few seconds before the spray is discontinued.

The operation will require to be quickly carried out ; if an assistant be available, the spray can be continued during its progress.

The method is not applicable if a difficult extraction is anticipated, or where acute inflammation of the mucous membrane or periosteum is present, or where there is sensitive dentine, or an exposed pulp in the neighbourhood. Under these conditions, which are those for which teeth are generally removed, the access of cold would give rise to acute pain.

For single loose teeth or roots the method may be employed, but it presents no advantages over other methods.

The Injection of Drugs for the Production of Local Analgesia.

A large number of drugs have been suggested, used, and equally praised by their various advocates, seeming to prove that their action depends not so much on what the drug contains as on its physiological effect on the nerve elements. Probably this is of a toxic or poisoning nature, acting temporarily as a block to their conducting power.

Those most commonly in use are cocaine, eucaine, stovaine, and novocaine, although it is to be deprecated that proprietary articles find favour with many.

Adrenalin (0·1 per cent.) or suprarenal extract may be advantageously combined with any of the above for the purpose of localizing and so prolonging their action; likewise its constricting effect on the arterioles, causing blanching, serves a useful purpose in determining when the tissues are well infiltrated and ready for operation.

Cocaine (cocaine hydrochloride), although generally claimed as effective for local analgesia, decomposes on boiling, and is liable to produce constitutional symptoms from its depressing action on the circulation through the medulla.

B. Eucaine can be rendered sterile by boiling. It is not, perhaps, quite so effective as cocaine, but is less toxic. It is slightly irritant.

Stovaine (hydrochlorate of amylene) is acid in reaction, and liable to cause local irritation and sloughing. It can, however, be rendered sterile, and in the hands of some has given excellent results.

Novocaine has so far not had any unfavourable quality ascribed to it. It is freely soluble in distilled water, can be rendered sterile without decomposition, is non-irritant, and its toxic properties do not appear to be pronounced.

In using any of the above drugs, the salt may be dissolved in distilled water according to the strength required, and sodium chloride added to make an isotonic solution (0·91 per cent. sodium chloride). Glucose is used for a similar purpose. A few drops of adrenalin chloride (0·1 per cent.) are then added, and the solution brought up to the boiling-point.

For preference these solutions should be used at the temperature of the body.

Lang* mentions the following solutions as isotonic with blood, and containing respectively 0·4 per cent., 0·8 per cent., and 0·2 per cent. novocaine, with three drops of adrenalin (0·1 per cent.) added to each 10 c.c.

<i>Solution.</i>	<i>A.</i>	<i>B.</i>	<i>C.</i>
Novocaine (4 per cent.) ...	1 c.c.	2 c.c.	5 c.c.
Saline (4 per cent.) ...	2 c.c.	2 c.c.	2 c.c.
Adrenalin (0·1 per cent.) ...	3 drops	3 drops	3 drops
Water, to ...	10 c.c.	10 c.c.	10 c.c.

The drug may, if desirable, be procured in the form of tabloids or ampoules of a definite strength. In the latter case it has previously been sterilized, and is ready for use.

Personally, I prefer making and sterilizing my own solutions as required, especially as the capsules in which the drug is usually presented do not satisfactorily allow the needle of the syringe to reach the contents.

The above drugs are generally used in 0·5 to 2 per cent. solutions. With a weaker solution a larger quantity of the drug can be employed, as it is found to be less toxic under these conditions. In the case of cocaine, not more than half a grain should be injected at one visit, and this for safeness had better be conducted with the patient in the supine or semi-recumbent position. A few minims of adrenalin chloride (0·1 per cent.) may be advantageously

* *St. Bartholomew's Hospital Journal*, January, 1908.

added to any of the above solutions, and should be sterilized either before or after its addition to the solution; the latter for convenience on account of its small bulk.

Unfavourable symptoms from the use of any of the above drugs do not necessarily depend upon the quantity employed; what may be a safe dose for one person may have harmful effects on others. Patients vary in their idiosyncrasy to various drugs.

Anæmic patients and those liable to giddiness and faintness are not good subjects for local anæsthesia, and small doses may give rise to further depression of their circulatory organs.

These drugs at first have a stimulating effect on the central nervous system, so that the patient becomes talkative and excitable. The pulse-rate is somewhat increased and more forcible, and likewise the respiration, the patient even becoming restless. Following upon this condition the patient may become pale, complain of a feeling of nausea, and his respiration less frequent.

Toxic symptoms have been chiefly recorded in connexion with cocaine.

Patients become pale and faint, and if not supported will fall forward in the chair; the pulse becomes quickened, weak or imperceptible at the wrist, the respiration quiet and shallow. There is often unconsciousness for a few seconds, with sudden return to consciousness. The patient falls into a cold sweat and somewhat revives again, frequently to be overtaken by one or more similar attacks.

For the rest of the day the patient will often complain of headache, giddiness, and perhaps nausea or vomiting, although the latter more frequently follows the return to consciousness.

If the patient be in the dental chair, his head should be

thrown well forward, or, better still, the back of the chair lowered so that he assumes the supine position. His body should be kept warm with blankets or rugs, and any tight clothing loosened. Brandy or an ether draught should be administered, or, if unconsciousness continues, ether (5i.) or some other powerful cardiac stimulant may be hypodermically injected.

The patient must be watched throughout, and at the first sign of respiration failing artificial respiration must be resorted to. The first measures are those of most importance—*i.e.*, position and warmth. However, as it cannot be foretold whether a case is likely to give rise to anxiety, no time should be lost in preparing for emergencies.

Technique of Infiltration Analgesia.

The Syringe.—It is to a large extent owing to improvements in this that have led to a fresh stimulus in local anæsthesia. Formerly a hypodermic syringe was utilized, and this failed both on account of the junctions being insufficiently watertight and the syringe too weak for infiltrating firm resistant tissue like the gum. The fluid escaped at the junctions or leaked back above the asbestos piston.

A good syringe should be powerful, contain a solid, well-fitting metal piston, for preference the same length as the barrel. The upper part of the barrel is fitted with a stout cross-piece, enabling the operator to obtain a firm grasp, whilst the piston is propelled into it with the thumb or palm of the hand. All junctions must fit accurately. The needle should not be over $\frac{1}{2}$ inch in length, and sufficiently stout for strength. It should screw on the syringe, and abut against a firm washer for additional safety. Straight

and curved needles are required, and when not in use a fine wire is kept in them.

Preferably the shaft and hilt should be in one piece. This saves a joint, and the shoulder so formed presses against the puncture and prevents leakage.

The syringe must be made so that it can easily be taken to pieces, and every portion rendered capable of sterilization.

The metal piston is graduated in minims, and the barrel should be capable of containing at least $\frac{1}{2}$ drachm. An additional scale in cubic centimetres is also a convenience for solutions which are put up in this measure, and may be conveniently superimposed on the smaller minim scale.

A small sterilizer should be kept apart for sterilizing the syringe and its accessories, as traces of alkalies are injurious to the action of these drugs. A metal piston will require some lubricant after removal from the sterilizer, and for this purpose a drop of pure lysol may be smeared over its surface.

Instead of boiling the syringe before use, which, although the safest means of rendering it sterile, is somewhat injurious to its smooth working, the syringe, after being cleansed, may be kept in lysol (10 to 20 per cent.) until again required.

Lang recommends a solution containing formaldehyde (formalin 20 per cent.) and borax (3 per cent.) for this purpose.

Prior to injection the mouth should be rinsed with a weak antiseptic, and the site of puncture wiped with a stronger solution on cotton-wool.

If the prick be feared, the gum may be previously touched with a little pure carbolic acid, or a solution of cocaine (saturated) applied on a small pellet of cotton-wool, either of which will render the gum insensitive to the needle.

A prick is made *obliquely into the gum* rather nearer the neck of the tooth than its apex, and to one side of its root where the amount of soft tissue is less scanty. When the eye of the needle is well buried in the mucous membrane, the solution can be slowly injected and the needle pushed on towards the apex of the tooth.

One injection on either side of the gum usually suffices for a single-rooted tooth, whereas for a molar it is generally advisable to inject in two places on its outer aspect, and in one or two on its inner side.

The injection should be made *slowly and gradually*, occupying about a minute over each puncture, and the needle retained *in situ* for a few seconds even after the barrel has been discharged. If but little resistance is offered, or, on the other hand, the piston cannot be driven on, the needle should be reinserted. The former indicates that the needle has not been properly inserted, or that there has been leakage of the solution outside the tissues, whereas the opposite condition generally implies that the eye of the needle has become occluded by the alveolus of the jaw.

About 20 minims of a 2 per cent. solution of any of the above-mentioned drugs suffices to anæsthetize one tooth, and less is required in proportion if anæsthetizing two or three adjacent teeth, as the analgesic zone from one puncture tends to spread to the teeth on either side.

A successful injection can be anticipated by the *resistance* offered, and becomes apparent by the brawny feeling imparted to the tissues, well described as of a "cheesy" consistency. In addition, blanching is well marked when adrenalin has been combined with the solution.

The whole area occupied by the tooth and its adjacent neighbours should appear blanched and feel "cheesy," and be allowed to remain in this condition for *four or five*

minutes before extraction is undertaken. The mucous membrane may also be tested previously with the point of the needle.

The fluid will often collect in the looser tissue towards the sulcus of the cheek and floor of the mouth. This, however, generally indicates that more is used than necessary.

Where the mucous membrane is healthy and firm, it is more readily infiltrated than when inflamed and thickened. In the latter condition the infiltrated tissues present more of a boggy feeling.

Difficulties arise both from the position of the tooth and its pathological condition. For back teeth a mouth mirror frequently has to be brought into use, while in connexion with the latter there may be an abscess, sinus, or, what gives rise to more trouble, the tooth may have been previously fractured and its socket damaged, allowing the solution to escape as fast as it is injected.

If the needle breaks in the gum, as a rule it is easily removed; but if this accident occurs while injecting the inner surface of the lower jaw, more especially in the molar region, there may be great difficulty in removing the broken piece; and should this make its way into the floor of the mouth among the muscles of the tongue, or into the submaxillary gland, no time should be lost in having the needle localized by skiagraphy and removed. The needle will rapidly travel in muscular or glandular tissue, and its point of entrance will soon cease to be a guide to its present position. . . .

For this reason I have discarded the long slender needles, having had the misfortune of breaking one of these while injecting the inner surface of the gum around a lower molar. The broken portion could not be seen or felt either before or after the extraction of the tooth. On

the following day the broken portion was localized by skiagraphy, a small incision made in the floor of the mouth, and after a prolonged search the broken portion recovered.

As previously mentioned, most practitioners have their favourite drug, and are naturally reluctant to try others when they have found one which is efficient, especially when the large number of these is considered.

For some time I worked with stovaine, but certainly found in a few cases that this irritated the tissues, and in one case produced a small slough in the floor of the mouth near the site of puncture.

Recently I have used novocaine, and so far have had satisfactory results from it; but no doubt there are many other drugs which are equally efficacious.

Dr. Sauvez, who has had one of the largest experiences of local anæsthesia for dental work, advocates cocaine (1 per cent. solution), but takes the precaution of placing his patient in the supine position while the drug is injected, and for some considerable time after its use.

For general surgical purposes, there are equally prominent advocates and opponents of this drug, apparently showing that its use and limits are not yet fully understood.

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